COASTAL COMMUNITY RESILIENCE GRANT PROGRAM FY16

RFR ENV 16 CZM 01

Applicant Town of Brewster
Address: 2198 Main Street
Brewster, Massachusetts 01631-1898

Local Project Manager:

Name:	Christopher Miller
Department:	Natural Resources
Email:	cmiller@brewster-ma.gov
Phone:	(508) 896- 4546
Fax:	(508) 896- 8089

Type of Adaptation Project (StormSmart climate adaptation action):

- Conducting public education and awareness or other communication initiatives
- Assessing vulnerability and risk
- Identifying and implementing management measures, standards, or policies
- Redesigning to accommodate changing conditions

Project Title: Developing a Coastal Adaptation Strategy for Brewster

Total Project Cost: $221,944

Match Amount: $62,470

Grant Amount Requested: $159,474

Project Summary

The Town of Brewster proposes to develop a consensus-based Coastal Adaptation Strategy. We believe that a measured and detailed public engagement process is the next step in adapting to Brewster's future coastal change and erosion issues.

We will:

A. Conduct a vulnerability and risk assessment that will establish a science-based foundation for policy dialogue on coastal resilience and adaptation
B. Engage in a facilitated public participation process that expands citizen, town staff and town committee member's understanding of these vulnerabilities; and builds capacity for evaluating management strategies to respond to changing climate conditions
C. Collect appropriate data and conduct an alternatives analysis of adaptation and resiliency options, responsive to the vulnerability assessment and public consensus
D. Develop a final Strategy that identifies management measures, standards and policies that will enable the Town of Brewster to adapt to, and redesign to accommodate our changing coastal conditions

Developing a Coastal Adaptation Strategy for Brewster
RFR ENV 16 CZM 01

Coastal Hazards Management

The Town of Brewster has 7 miles (11.3 km) of coastline on Cape Cod Bay, with 10 parking areas/landings for beach access (Map 1). The Town has also purchased and protected essentially all of the salt marsh in our two estuaries; Quivett/Paines Creek at the west bordering Dennis, and Namskaket at the east, bordering Orleans. These marshes provide significant ecosystem services that are important to protect as sea level rises. The Quivett/Paines Creek saltmarsh system has a conservation restriction granted to the Commonwealth of Massachusetts EOEEA, while the Namskaket marsh is a part of the Inner Cape Cod Bay Area of Critical Environmental Concern (ICCB ACEC).

The Town has been actively engaged in coastal retreat and adaptation for a number of years. At Paines Creek Landing, we removed one of our larger public parking lots that had suffered repetitive storm damage and restored the dune and beach. The new parking area is further inland with a walkway to the beach. We are in the process of implementing a similar but improved retreat design at Breakwater Beach, another town beach and parking lot, with CZM coastal community resiliency grant (CCRG) funds. We are also currently in the permitting phase of a partial retreat and removal of a revetment at Ellis Landing.

We have a regular program of beach nourishment at several beaches suffering annual erosion. At most landings, Brewster has developed sacrificial vegetated dunes and sand drift fence to lessen the impacts of coastal storm events. In the last 5 years we have added two new stairways to the beach over coastal bank and dune deposits that reduce erosion from foot traffic and allow the dune deposits to move (Breakwater Landing and Spruce Hill Conservation Area). Two years ago at Linnell Landing, we constructed a handicap-accessible platform on piles that is resilient to seasonal fluctuations in beach elevation.

We have also focused on capturing and treating stormwater, using a watershed based approach. In the last 6 years we have implemented stormwater retention and infiltration projects at Paines Creek Landing and Saints Landing. We currently have permitted stormwater projects for Ellis Landing Road and Linnell Landing Roads, neither of which have any current controls, which we plan to construct in fall of 2015.

In the last 6 years we have done two large coastal culvert replacements designed to restore flow to large areas of salt marsh and essential river herring habitat at Stony Brook and Paines Creek and to Brewster's only salt pond, Freemans Pond. These largely federally funded projects improved resiliency and provide flood storage and damage prevention.

Each of these projects has had strong support at Town meeting and through state and federal funding partners.

In 2013 the Brewster Board of Selectmen established a seven-member Coastal Committee, charged with developing a management plan for Brewster's coastal resources.

Climate Adaptation

Brewster's entire coast is currently in the FEMA VE flood zone and most or all of its tidal marsh and creek system are mapped as AE. There are 1,138 land parcels within these zones. In the past five years, extensive parts of coastal Brewster have been exposed to storm surge impacts, including dune washover, flooding and significant erosion. In some areas, up to 20 feet of dune/coastal bank have been lost in a single storm event.

Initial results of the century-scale sediment budget for Brewster (CZM CCRG-funded) indicate that erosion is the dominant process along our coast from west to east. Accretion occurs in the eastern region of the coast; however most of this sediment is being deposited offshore. The study suggests that, since the

prevailing winter wind direction in Cape Cod Bay is northwesterly, this eastward flow of sediment is driven primarily by northwesterly wind waves. **Thus, one significant challenge for Brewster with regard to climate change is the impact of increasing frequency and intensity of storms on a mostly eroding coast.**

Like its neighbors, Brewster's beaches are in high demand. Residents and visitors alike enjoy our coast, evidenced by the fact that Brewster sold 6,411 resident beach stickers and 4,355 seasonal and visitor stickers in 2014; however, our parking is limited with approximately 300 spaces available.

One of Brewster's largest beaches is located at Wing Island, at the western border of town. The island consists of 32.5 acres of upland with 12 acres of beach, but is only accessible through a right of way behind private property at the Cape Cod Museum of Natural History, then across approximately ¼ mile of salt marsh along marsh planks. At present this path floods within approximately 2 hours of high tide.

Close to half of Brewster's residential properties (~49%) are owned by nonresident taxpayers and many of these homes overlook the beaches or are in coastal neighborhoods. These properties are in the highest property tax category, so there are financial incentives for both the owners and the town to protect them.

The Brewster Conservation Commission is under pressure to allow hardening, beach fencing and other so-called soft solutions, for more of our coastal properties. These measures protect the structures behind them for some period of time; however the beach and other natural resources are adversely impacted.

Many of the original structures built along our beaches have been renovated, expanded, or torn down and rebuilt by new owners unfamiliar with the potential for storm damage and an eroding coastline. These substantial investments include teams of lawyers and engineers who often propose significant coastal structures and armoring to protect these properties. Our conservation commission does not have the level of expertise and data about Brewster's coast to fully evaluate these proposals and their long term pros and cons.

As noted above, Brewster has embraced coastal retreat of its public infrastructure, to minimize environmental damage and reduce taxpayer costs for repetitive losses. While we've attempted to replace parking lost to retreat, we are unlikely to maintain the number of spaces with our current access opportunities.

We've learned the hard way that without thorough community engagement and a more comprehensive approach to coastal adaptation and resiliency, projects that are technically well designed and appropriate for the location, can be halted in either the funding or permitting process if citizens object to the project. Brewster's Breakwater beach retreat, dune restoration and green stormwater management plan, funded in last year's round of CZM CCRC grants, is now in the DEP appeals process. Citizen opposition has many layers; however an important message out of this is the need for a more comprehensive plan for addressing coastal change.

Project Description

The Town of Brewster proposes to develop a consensus-based Coastal Adaptation Strategy. We believe that a measured and detailed public engagement process is the next step in adapting to Brewster's future coastal change and erosion issues. We believe our proposal addresses all four of the StormSmart climate adaptation actions (numerically noted below).

Developing a Coastal Adaptation Strategy for Brewster
RFR ENV 16 CZM 01

We will:

A. Conduct a vulnerability and risk assessment that will establish a science-based foundation for policy dialogue on coastal resilience and adaptation *(#2)*
B. Engage in a facilitated public participation process that expands citizen, town staff and town committee member's understanding of these vulnerabilities; and builds capacity for evaluating management strategies to respond to changing climate conditions *(#1)*
C. Collect appropriate data and conduct an alternatives analysis of adaptation and resiliency options, responsive to the vulnerability assessment and public consensus (#3 +4)
D. Develop a final Strategy that identifies management measures, standards and policies that will enable the Town of Brewster to adapt to, and redesign to accommodate our changing coastal conditions

Under this grant, the Town of Brewster and its consultants (the Project Team) will develop Brewster's Coastal Adaptation Strategy, based on a vulnerability and risk assessment associated with climate change through extensive public input and guidance. Our project team consists of two groups:

Public Engagement team

- The Consensus Building Institute (CBI);
- The Cape Cod Commission (the Commission);
- Brewster Coastal Committee (BCC); and
- Town of Brewster staff

Technical Advisory team

- Horsley Witten Group (HWG);
- Coastal Geologist, LEC Environmental
- The Association to Preserve Cape Cod (APCC); and
- The Center for Coastal Studies (the Center)

To successfully educate and engage Brewster residents and build consensus on a framework for adaptation decisions, we will convene and facilitate a representative Brewster Coastal Advisory Group (BCAG) to provide targeted input and help guide strategy decisions, in collaboration with Brewster's Coastal Committee (BCC). All BCAG meetings would be open to the public and include time for public input. The BCAG will be engaged during the initial data gathering and vulnerability assessment process.

The Town will convene a Public Visioning Workshop to initiate public discussion of the central questions for the project—what does the community envision for its coastal areas, and how can that vision be made more resilient to the impacts of climate change?

To support the discussion, the Project Team will provide data and visualizations of current and future risk, gathering public input on community priorities. A mixture of presentation, full- and small-group discussion, keypad polling, and other techniques and technologies will be used to conduct an engaging and innovative workshop. A project website will be developed where maps, data, plans, and resources generated during the process will be available to the BBCC, BCAG and the public.

Over the course of 3 to 5 meetings the BCAG and the BCC will examine the vulnerability assessment and scientific analysis of exposures and risks to Brewster's coast, and public and private infrastructure, from changing climate conditions to assess a range of alternatives that could reasonably address community interests and concerns. They will present the findings of their alternative analysis for public reaction to identify outstanding questions, spur further analysis if necessary, and, ultimately, develop better alternatives to include in an adaptation strategy.

Based on the public's reaction to the range of alternatives and the technical advisory team review, the BCAG and BCC, with assistance from the Project Team, will prioritize preferred elements among adaptation options, including potential costs, environmental impact and regulatory barriers for each type of coastal vulnerability. The group will seek to identify specific adaptation actions, opportunities and future studies that are most appropriate for Brewster and that will move the community toward resiliency to climate change. Options include:

- land use policies, including land acquisition and conservation restrictions*
- zoning and other regulatory changes, including changes to the Town's floodplain bylaw*; site plan review*;health regulations on septic systems that address sea level rise*; local wetlands bylaw and regulations that address buffers, setbacks and activities proposed for land subject to coastal storm flowage*
- financial incentives for retreat and increase resiliency
- public access alternatives, such as evaluating remote parking and shuttle bus system
- architectural or engineering considerations*
- Changes in seawalls and other hardened structures to accommodate a higher sea level
- Improvements to existing stormwater management facilities to better handle large storms and flooding events
- Green stormwater infrastructure

* Recommendations in the Massachusetts Climate Change Adaptation Report

The recommended strategies will be prioritized based on temporal urgency (whether they become critical in the near-, mid-, and long-term) and implementation potential (for example, the feasibility of a policy improvement or whether a capital investment is needed).

The BCAG, BCC and the Project Team will finalize the Strategy and hold a final community meeting to present and discuss the Coastal Adaptation Strategy. The Board of Selectmen will formally adopt the Strategy and direct appropriate town departments, boards and committees to incorporate these strategies into their activities.

Public Engagement

The *Public Engagement team*, led by CBI, will assist the Town of Brewster on public engagement and consensus building for a community Coastal Adaptation Strategy.

A. **Initial Scoping and Advisory Group Development** – To successfully educate and engage Brewster residents and build consensus on a framework for adaptation decisions, CBI would facilitate both broad public outreach and education as well as convene and facilitate a representative advisory group to provide targeted input and help guide strategy decisions. All advisory group meetings would be open to the public and include time for public input. These activities would occur during the initial data gathering and vulnerability assessment process.

   Tasks

   - Work with the Town and the Brewster Coastal Committee (BCC) to understand the range of interests and concerns, identify an initial set of key stakeholders who might represent these interests, and conduct brief interviews or focus group meetings with these and additional stakeholders to identify their understanding of the issues, concerns, and process needs. Based on these conversations, we would develop and refine recommendations for convening a representative advisory group (Brewster Coastal Advisory Group or BCAG) who could serve as active partners throughout the project.

- Help convene the advisory group to seek input on the overall goals, objectives, and work plan to better reflect the needs, opportunities and constraints of the community.
- Bring together the advisory group in an initial meeting to review process protocols, charter, and work plan; ensure representation of all stakeholder groups and interests in the Town; and explore initial scenario development questions (such as sea level rise assumptions and planning time horizon) to inform the vulnerability assessment and prepare for a public visioning meeting.
- Support creation of a project website where maps, data, plans, and resources generated during the process will be available to the BCC, BCAG and the public.

Deliverables

- Recommended process design for advisory group.
- Revised overall project work plan
- Advisory group work plan, charter, and meeting guidelines.
- Agenda and meeting summaries from advisory group meeting.
- Project website
- Televised Meetings and video-archived on Town web page

Time frame: August to October 2015

B. **Public Visioning Workshop** - CBI will help to convene and facilitate a public kick-off meeting to initiate public discussion of the central questions for the project – what does the community envision for its coastal areas and how can that vision be made more resilient to rising sea levels? To support the discussion, the technical project team will provide data and visualizations of current and future risk, the range of emerging adaptation approaches and case studies, and gathering public input on community priorities. CBI will draw on a mixture of presentation, full- and small-group discussion, keypad polling, and other techniques and technologies to conduct an engaging and innovative workshop.

Tasks

- Work with the Technical Project team to convene a public workshop to:
  - introduce the BCC, BCAG, and Technical Team;
  - define the problem and present project approach and goals;
  - share introductory material on sea level rise and coastal hazards;
  - showcase potential strategies to address sea level rise and coastal storms; and
  - gather perspective on threats to Brewster's coast and public and private coastal infrastructure and their priorities, goals, and desires for Brewster's coastal areas.

Deliverables:

- Agenda, meeting materials, and meeting summary highlighting community perspective on threats to public and private infrastructure, and priorities, goals and desires for Brewster's coastal areas.
- Televised Meetings and video-archived on Town web page

Time frame: October - November 2015

C. **Alternatives Analysis** - With guidance from community input, the BCAG will examine the vulnerability assessment and scientific analysis of exposures and risks to Brewster's coast, and public and private infrastructure, from changing climate conditions to assess a range of alternatives that could reasonably address community interests and concerns. The BCAG would present the findings of their alternative analysis for public reaction to identify outstanding questions, spur further analysis if necessary, and, ultimately, develop better alternatives to include in an adaptation strategy.

Tasks

- Convene, facilitate, and document 3 - 5 advisory group meetings to identify a set of strategies and mechanisms would address the key community issues and priorities. To identify the strategies, CBI would help the group:
    - review vulnerability assessment data, and in-depth information on adaptation strategies including land use planning and policy tools, shoreline engineering strategies, permitting guidelines, etc., and information from the public workshop
    - evaluate areas suitable for future development/redevelopment, shoreline protection, and strategic relocation or no action
    - determine the interplay between infrastructure lifecycles and changing risks to determine the benefit-cost of upgrading or siting new infrastructure, and
    - identify key economic or strategic questions that may require deeper cost-benefit analysis and/or social vulnerability considerations.
- Convene a facilitated public meeting (or BCC meeting) for the BCAG to present what they learned about the adaptation alternatives and the extent to which each alternative may address the community's priority interests and needs. Facilitate discussion of the findings to identify the communities preferred adaptation strategies.

Deliverables

- Agendas, meeting materials, and meeting summary for each meeting.
- Televised Meetings and video-archived on Town web page

Time frame: December 2015 - March 2016

D. **Adaptation Strategy Development -** During this phase, the BCAG will prioritize preferred elements among adaptation options, including potential costs, environmental impact and regulatory barriers for each type of coastal vulnerability. The group will seek to identify specific adaptation actions, opportunities and future studies that will move the community toward resiliency to sea level rise. Cape Cod Commission will assist in evaluating adaptation strategies, particularly those related floodplain management.

Tasks

- Convene, facilitate, and document 2 - 4 additional BCAG meetings to select a suite of preferred adaptation strategies that are most appropriate for Brewster.
- Prioritize recommended strategies based on temporal urgency (whether they become critical in the near-, mid-, and long-term) and implementation potential (for example, the feasibility of a policy improvement or whether a capital investment is needed)

Deliverables

- Agendas, meeting materials, and meeting summary for each meeting.
- Assist in development of draft Coastal Adaptation Strategy Report, incorporating considerations from the vulnerability assessment and public engagement efforts.
- Televised Meetings and video-archived on Town web page

Time frame: March - June 2016

E. **Draft and Final Coastal Adaptation Report and Public Release-** The project team, the BCAG, and the BCC will jointly release and communicate the essential messages to the greater Brewster public. The Project Team will prepare a summary report describing the work undertaken in this project and the

recommendations for potential adaptation strategies. The report will describe data sources, assessment methodologies, maps, vulnerable/impacted assets, potential adaptation options, and the options' relative costs and benefits. An executive summary will be provided along with a recommended implementation plan showing a schedule for when proposed actions should be implemented.

A draft report will be prepared for review and comment by town residents and other stakeholder organizations. Following receipt of comments and after discussions with the Brewster Advisory Group, a final report will be prepared.

Tasks

- Work with the BCAG to draft, revise, and finalize the final adaptation strategy.
- Work with the Town of Brewster to plan and convene a final community symposium on the results of the project.
- Disseminate the final adaptation strategy document in hard copy and online.

Deliverables

- Assist finalizing the Brewster Coastal Adaptation Strategy Report
- Agenda, meeting materials, and summary of public meeting

Time frame: June 2016

Technical Team

The *Technical Advisory team*, led by HWG, will complete five major tasks:

1. Mapping and evaluation of the natural systems along Brewster's coast to understand the shoreline under future conditions (continued shoreline erosion, sea level rise (SLR) and storm surge that will impact areas further inland). This will include the use of visualization tools and graphics that will help Town residents and other stakeholders understand the future of the Town's shoreline and the impacts of climate change.
2. Developing maps and visualization products to identify the extent to which public and private development and associated infrastructure will be impacted by climate change.
3. Identification of opportunities to adapt to future conditions through retreat strategies, wetland migration, regulations on future development, retrofits of existing properties and structures, such as the ongoing Breakwater Landing parking lot retreat and dune restoration, and other appropriate strategies. Like Breakwater Landing, many of the Town's access points to the beach on Cape Cod Bay are threatened by coastal erosion, and there are limited opportunities to move parking facilities further from the coast. Therefore, opportunities for remote parking and shuttle services will be analyzed.
4. Development of the Town's Coastal Adaptation Plan describing the proposed strategies and how they will be implemented across Brewster, including potential updates to Brewster's Local Comprehensive Plan.
5. A comprehensive public involvement process to translate this information to Town officials and the general public in a way that allows the community to select adaptation approaches to protect its coastal areas.

1. Analysis of Coastal Erosion Data and Prediction of the Future Coastline

Under a previous coastal resiliency grant, the Center for Coastal Studies analyzed sediment transport along Brewster's Cape Cod Bay shoreline and estimated the areas where erosion is occurring and where sediment deposition is taking place. These data will be used along with the existing shoreline change mapping to

predict the extent of erosion along the coast over the foreseeable future. Data from ongoing private beach nourishment projects will be gathered and evaluated to determine how significant these sediment additions are, both now, and in the future. The exact timing for the erosion predictions will be based on the analysis of the available data, and it is anticipated that two shoreline erosion scenarios will be developed. The timing of the erosion simulations will likely be consistent with those used for mapping SLR and this will be discussed through the stakeholder process.

2. Identification of tidal, sea level rise, and storm surge parameters

The Project Team will identify tidal, SLR, and storm surge scenarios for short and long term planning horizons (e.g., 25 year and 50 year) to be evaluated for this project. This will include two global mean sea level rise scenarios as published in the *NOAA Technical Report Global Sea Level Rise Scenarios for the United States National Climate Assessment* (December, 2012) and using guidance from the CZM Stormsmart Coasts web site and MCZM's 2013 report, *Sea Level Rise: Understanding and Applying Trends and Future Scenarios for Analysis and Planning*. The Project team will also consider other local or relative SLR projections such as those available in the U.S. Environmental Protection Agency's CREAT application (Climate Resilience Evaluation and Awareness Tool). Options for SLR scenarios will be discussed and agreed upon with the BCAG and BCC. We anticipate applying the MCZM intermediate –high SLR scenario.

3. Erosion, SLR, and Storm Surge Mapping

The Project Team will create maps showing the inland progression of shoreline erosion based on the information developed in Task 1. The Team will also develop sea level rise projection/inundation maps for three SLR projection scenarios at two time periods for the entire Brewster coastline.

To develop these maps, the Project team will make use of available LiDAR (Light Detection and Ranging) data that HW, on behalf of the Town, has already translated and incorporated into past projects for the Integrated Water Resource Management Plan. To further understand impacts from storm surge events, the Team will utilize the results of Sea, Lake, and Overland Surges from Hurricanes (SLOSH) modeling (performed by the Commonwealth of Massachusetts) to create maps and 3-D renderings.

In addition to Town-scale maps illustrating inundation from SLR and storm surge scenarios, two site-specific maps will be prepared to demonstrate shoreline erosion and SLR inundation impacts at a more focused scale. The goal will be to focus on specific vulnerable areas of concern, such as at one of the public beach landings and within a tributary salt marsh, and illustrate potential inundation conditions in varying environments in Brewster. For each of these specific areas, the Project Team will also create one photographic rendering in addition to a static GIS-based map.

4. 3D SLR and Storm Surge Animation/Visualizations Under Future Erosion Conditions

The Project Team will utilize the most current technologies to create 3D photographic renderings illustrating SLR and storm surge along the Brewster shoreline. Using Oblique 3D images from Google Earth Pro and Bing Bird's Eye View, as well as Autodesk Infraworks and other infrastructure visualization technologies an animation for a portion of the Brewster coastline will be prepared to illustrate current and future conditions using selected erosion, SLR and storm surge scenarios.

The site-specific maps, photographic renderings, and 3D visualization will play a critical role in community outreach and education on the subject of climate vulnerability. A picture is indeed worth a thousand words when communicating technically complicated topics to the general public.

In addition to the proposed graphics that will illustrate future climate scenarios, existing information will be gathered to demonstrate to the public how climate change may impact the community. The graphics will also indicate the extent of the King Tide.

Finally, the Project Team will incorporate existing data on how groundwater levels near the coast will respond to SLR. Under the Town's Integrated Water Resource Management Plan, the areas where SLR could impact the functionality of septic systems were identified based on estimated changes in groundwater levels near the coast. Since then, the U.S. Geological Survey has developed a model for all of Cape Cod predicted water levels under SLR scenarios. Data from both projects will be used to update the analysis of showing the number of onsite systems that will be impacted by rising groundwater levels. HW, one of the proposed consultants for this project, is working with EPA Region 1 to assess onsite system impacts from climate change. It is anticipated that information developed from this project, to be completed early 2016, can be incorporated into the Town's Resiliency Plan.

Time Frame: through October 2015

5. Identification of Vulnerable Natural Resources and Built Infrastructure

The Project Team will use the data and maps created in Tasks 1-4 with additional data obtained from the Town' GIS database (e.g., land use, natural resources, parcels, public works) to identify the degree to which infrastructure and natural resources are vulnerable relative to the estimated levels of erosion and SLR. This will build on the inventory of natural resources and measures of their resiliency conducted by APCC as part of the 2014 Community Resiliency Grant award to Brewster.

The Team will inventory and assess the existing condition of public infrastructure and natural and recreational resources that would be impacted by the various inundation scenarios. Public infrastructure of interest includes, but is not limited to: Town landings providing public access to the beach; scenic roads used for walking and biking; drainage systems, roads; utilities; and critical facilities. Natural resources include, but are not limited to: open space, beaches, banks, salt marshes, ponds, parks, and conservation land.

The Project Team will also quantify the number of private buildings and associated onsite septic systems that are at risk based on the mapping and vulnerability analysis. A matrix will be developed to rank those risks to assets based on risk and vulnerability criteria that are deemed to be important. These criteria may include:

- Elevation above predicted flood stages
- Proximity to future shoreline based on predicted erosion rates
- Estimated replacement costs based on order of magnitude
- Assessor's valuation
- Public access considerations (especially for Town Landings)
- Age
- Habitat value
- Public health and safety value

These criteria will be finalized as data are developed and will be weighted and a scoring system will be developed to prioritize those assets for adaptation and mitigation efforts.

Time frame: initial draft in November 2015, revised through public process through March 2016

Developing a Coastal Adaptation Strategy for Brewster
RFR ENV 16 CZM 01

6. Development of Adaptation Strategies

The Project Team will prepare a suite of adaptation strategies, relative to vulnerable infrastructure and resources based on the vulnerability assessment tasks described above, to support the BCAG's and BCC's development of alternatives.

These adaptation strategies will prioritize short, mid, and long-term implementation potential and will be derived from a number of sources. For example, the Team will likely use information from the following regional reports: *Massachusetts Climate Change Adaptation Report* and *Sea Level Rise: Understanding and Applying Trends and Future Scenarios for Analysis and Planning,* and resources from CZM's StormSmart Coasts.

In addition, the Project Team will reference the U.S. EPA's Adaptation Strategies Guide for Water Utilities, published in 2013, to determine options for mitigating risks to water and stormwater infrastructure, as well as NOAA's report *Incorporating Sea Level Rise at the Local Level* (2012). Green engineering options may be suggested.

The Project Team will examine adaptation options based on a do-nothing, straight-line projection from historic conditions, and a predicted conditions context considering both the short and long term planning horizons and categorize adaptation strategies into three general categories to assist in developing the Coastal Adaptation Strategy.

- **No Regrets** - many options may provide benefits under current conditions and potential future erosion, SLR and coastal surge conditions. These options provide other, more immediate, economic, environmental, or social benefits regardless of future conditions. They are not necessarily cost free.
- **Low Regrets** - provide benefits particularly if erosion, SLR and coastal surge projections become reality.
- **Climate Justified** - actions that reduce greenhouse gas emissions and provide co-benefits (e.g., energy efficiency, energy stability/resilience, optimization and reduced operating costs).

The Project Team will also characterize the adaptation options by order of magnitude costs. For example, planning strategies tend to be relatively less costly than operational and capital strategies. As such, some planning options, such as holding regular discussions on climate adaptation at Town meetings, might be noted with one dollar sign ($), while moving critical infrastructure out of areas potentially impacted by SLR would be noted with three dollar signs ($$$).

A matrix of adaptation options will be presented to the BCAG for their review and discussion. An updated version will then be created based on the outcome of these discussions that can be used in the final strategy.

Time frame: March – June 2016

Brewster staff reviewed the projects, tools and resources found on the StormSmart Coasts program website. The discussion and reports found under Assessing Vulnerability of Coastal Areas and Properties were very helpful in developing the framework for our vulnerability assessment. Our proposal includes 3-D mapping tools for public education, similar to what was done for the Marshfield, Scituate and Duxbury Coastal Resiliency Initiative. As suggested in the MCZM's 2013 report: *Sea Level Rise: Understanding and Applying Trends and Future Scenarios for Analysis and Planning,* 25- and 50-year horizons for sea level rise will be used in our vulnerability assessment.

Developing a Coastal Adaptation Strategy for Brewster
RFR ENV 16 CZM 01

Transferability

We believe this project will serve as a model for building community consensus on the impacts of changing climate on a town's resources and, importantly, on strategies to address these impacts. Consensus won't guarantee there will not be conflict in the future, but it does establish a framework for future planning. It will also give private property owners a better understanding of how and why their beach is changing and how their actions relate to the entire coast of their community.

The mapping and visualization tools developed in this project can be replicated in other towns (similar to how Brewster replicated the basic approach used in the Marshfield, Scituate and Duxbury project).

Brewster's education and outreach efforts can easily be replicated by other communities, using their town website, community-access TV and regional and local partners. All meetings will be televised and video-archived. Each of the BCAG-BCC meetings will be linked to meeting videos on town website. Our project will have its own webpage on the Town's website that is accessible to anyone, easily replicated by any town. Project news and materials will be made available at the Town Library. The Association to Preserve Cape Cod (APCC) will use their extensive emailing list to distribute information on the project. The Brewster Conservation Trust (BCT), a coastal landowner and partner with the town on many land conservation efforts, also has an extensive mailing list and sends its newsletters to all taxpayers in Brewster. The Cape's regional planning agency, the Cape Cod Commission, is a partner in Brewster's project and will share information and lessons learned with other coastal towns, as the Commission provides planning and technical assistance on local hazard mitigation planning. The Commission's website will include a link to the Brewster project website.

Timeline

ACTION	START	INTERIM ACTIONS	COMPLETION
Scoping and Advisory Group Development	August 2015		October 2015
Analysis of Coastal Erosion Data and Prediction of the Future Coastline	August 2015	• Identification of tidal, SLR and storm surge parameters • Erosion, SLR and storm surge mapping • 3d SLR and Storm Surge Animation and Visualizations under Future Erosion Conditions	October 2015
Public Visioning Workshop	October 2015		November 2015
Identification of Vulnerable Natural Resource and Built Infrastructure	September 2015		March 2016
Alternatives Analysis	December 2015	• 3-5 BCAG/BCC meetings	March 2016
Adaptation Strategy Development	March 2016	• 2-4 BCAG/BCC meetings	June 2016
Development of Adaptation Strategies	March 2016		June 2016
Final Report and Public Forum	May 2016		June 2016

Developing a Coastal Adaptation Strategy for Brewster
RFR ENV 16 CZM 01

Budget summary (see attached proposals and detailed cost estimates).

	Grant funding	In-kind services	Town funding
Consensus Building Institute	$74,005		
Horsley Witten Group	$83,185		$7,970
Center for Coastal Studies	$2,284		
Cape Cod Commission		$4,500 to $6,200	
Association to Preserve Cape Cod		$10,000	
Town • Chris Miller, Project Manager • Sue Leven, Town Planner • Video services • Misc. staff time, coastal committee members, coastal advisory group		 $10,000 $2,000 $8,000 $20,000	
Subtotal	$159,474	$54,500	$7,910
Project total: $221,944 Required match at 25% is $55,486 **Provided match is $62,470, or 28%**			

Local Project Manager and Team Partners

Chris Miller, Brewster Natural Resources Department Director will work with Dr. Jo Ann Muramoto, APCC Senior Scientist, to manage the project and assist with public outreach. APCC has dedicated 10 hours of Dr. Muramoto's time over one year ($1,000) as match for project management, plus other in-kind services that together total $10,000 in match (see attached Letter of Support). The Town will provide over 250 hours for Chris Miller as match ($10,000). Chris Miller and Dr. Muramoto,have successfully worked together on other restoration and resource protection projects. The Team has an excellent track record, having both been recognized by the Coastal America Partnership and NOAA for projects in Brewster.

Town of Brewster

2198 Main Street
Brewster, MA 02631-1898
Phone: (508) 896-3701
Fax: (508) 896-8089

Office of:
Board of Selectmen
Town Administrator

June 11, 2015

Patricia Bowie, Coastal Resiliency Specialist
Executive Office of Energy & Environmental Affairs
Massachusetts Office of Coastal Zone Management
251 Causeway Street, Suite 800
Boston, MA 02114

RE: Coastal Community Resilience Grant Program FY16

Dear Ms. Bowie,

Please be advised that I, Charles L. Sumner, am the authorized signatory for the Town of Brewster.

The Town of Brewster commits to match a minimum of 25% of the total Coastal Community Resilience Grant project's cost and acknowledges that funding is provided by the State on a reimbursement basis.

The Town's match is $7,970 documented in a signed contract with Horsley Witten Group, dated April 30, 2015 (attached), plus an in-kind Town match of $40,000. The total match, including from partners, is $62,470, which exceeds the required 25% match.

Sincerely,

Charles L. Sumner
Town Administrator

LIST OF ATTACHMENTS

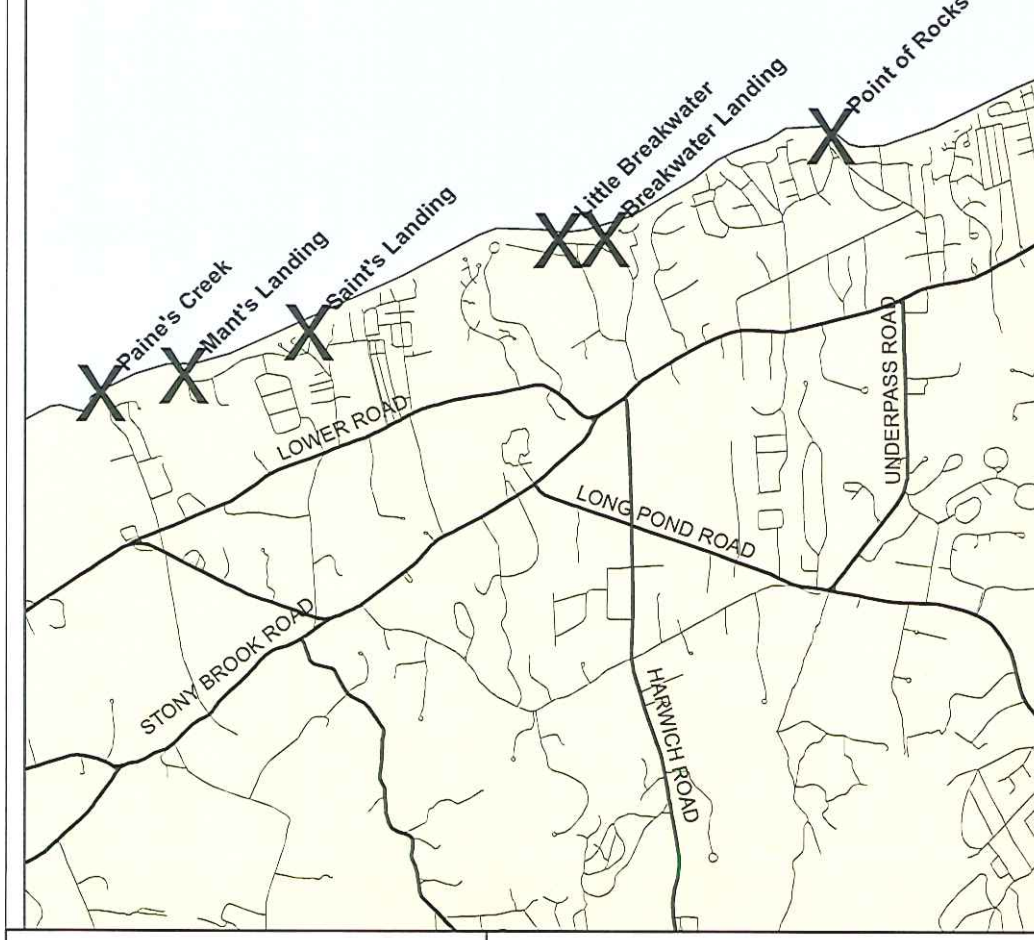
1. Map of Brewster Coast

2. Proposal and Budget Support

The Consensus Building Institute
Horsley Witten Group
The Cape Cod Commission
The Association to Preserve Cape Cod

3. Resumes
Chris Miller, Town of Brewster Project Manager
Jo Ann Muromoto, APCC, Assistant Project Manager
Stacie Nicole Smith, CBI Mediator
Eric Roberts, CBI Mediator
Mark E. Nelson, HWG, Sr. Hydrogeologist
Stan Humphries, LEC, Sr. Coastal Geologist
Heather McElroy, CCC, Natural Resources Specialist
Mark Borrelli, CCS, Coastal Geologist

3. Letters of Support
Ben deRuyter, Chair, Brewster Board of Selectmen
Robert Moran, Chief, Brewster Fire & Rescue Department
Richard J. Koch, Jr., Chief, Town of Brewster Police Department
James Gallagher, Conservation Administrator, Brewster Conservation Department
Susan M. Leven, AICP, Brewster Town Planner
Patrick Ellis, Superintendent, Brewster Department of Public Works
Victor E. Staley, Building Commissioner, Brewster Building Department
Kathy Cockcroft, Director, Brewster Ladies' Library
Edward J. DeWitt, Executive Director, The Association to Preserve Cape Cod
S. Kyle Hinkle, Executive Director, Brewster Chamber of Commerce



Town of Brewster
Conservation Department

Brewster Town Landings
Parking Areas

The Consensus Building Institute is pleased to assist the Town of Brewster on public engagement and consensus building for a community coastal adaptation strategy, which will serve as the foundation for a publically acceptable coastal adaptation plan. To help the Town achieve its goals of developing a science-based foundation for policy dialogue on coastal resilience and adaptation, building capacity for public engagement in the planning process, and developing an adaptation strategy, CBI would help to implement the following Work Plan.

A. **Initial Scoping and Advisory Group Development** – To successfully educate and engage Brewster residents and build consensus on a framework for adaptation decisions, CBI would facilitate both broad public outreach and education as well as convene and facilitate a representative advisory group to provide targeted input and help guide strategy decisions. All advisory group meetings would be open to the public and include time for public input. These activities would occur during the initial data gathering and vulnerability assessment process.

Tasks

- Work with the Town of Brewster and Coastal Committee to understand the range of interests and concerns, identify an initial set of key stakeholders who might represent these interests, and conduct brief interviews or focus group meetings with these and additional stakeholders to identify their understanding of the issues, concerns, and process needs. Based on these conversations, we would develop and refine recommendations for convening a representative advisory group who could serve as active partners throughout the project.
- Help convene the advisory group to seek input on the overall goals, objectives, and work plan to better reflect the needs, opportunities and constraints of the community.
- Bring together the advisory group in an initial meeting to review process protocols, charter, and work plan; ensure representation of all stakeholder groups and interests in the Town; and explore initial scenario development questions (such as sea level rise assumptions and planning time horizon) to inform the vulnerability assessment and prepare for a public visioning meeting.
- Support creation of a project website where maps, data, plans, and resources generated during the process will be available to the Coastal Committee, advisory group and the public.

Deliverables

- Recommended process design for advisory group.
- Revised overall project work plan
- Advisory group work plan, charter, and meeting guidelines.
- Agenda and meeting summaries from advisory group meeting.
- Project website

Time frame: August to October 2015

B. **Public Visioning Workshop** – CBI will help to convene and facilitate a public kick-off meeting to initiate public discussion of the central questions for the project—what does the community envision for its coastal areas and how can that vision be made more resilient to rising sea levels? To support the discussion, the project team will provide data and visualizations of current and future risk, the range of emerging adaptation approaches and case studies, and gathering public input on community priorities. CBI will draw on a mixture of presentation, full- and small-group discussion, keypad polling, and other techniques and technologies to conduct an engaging and innovative workshop.

Tasks

- Work with the Project team to convene a public workshop to:
  - introduce the Coastal Committee, Advisory Panel, and Technical Team;
  - define the problem and present project approach and goals;
  - share introductory material on sea level rise and coastal hazards;
  - showcase potential strategies to address sea level rise and coastal storms; and
  - gather perspective on threats to Brewster's coast and public and private coastal infrastructure and their priorities, goals, and desires for Brewster's coastal areas.

Deliverables:

- Agenda, meeting materials, and meeting summary highlighting community perspective on threats to public and private infrastructure, and priorities, goals and desires for Brewster's coastal areas.

Time frame: October - November 2015

C. **Alternatives Analysis** - With guidance from community input, the advisory group will examine the vulnerability assessment and scientific analysis of exposures and risks to Brewster's coast, and public and private infrastructure, from changing climate conditions to assess a range of alternatives that could reasonably address community interests and concerns. The advisory group would present the findings of their alternative analysis for public reaction to identify outstanding questions, spur further analysis if necessary, and, ultimately, develop better alternatives to include in an adaptation strategy.

Tasks

- Convene, facilitate, and document 3 - 5 advisory group meetings to identify a set of strategies and mechanisms would address the key

community issues and priorities. To identify the strategies, CBI would help the group:

- review vulnerability assessment data, and in-depth information on adaptation strategies including land use planning and policy tools, shoreline engineering strategies, permitting guidelines, etc., and information from the public workshop
- evaluate areas suitable for future development/redevelopment, shoreline protection, and strategic relocation or no action
- determine the interplay between infrastructure lifecycles and changing risks to determine the benefit-cost of upgrading or siting new infrastructure, and
- identify key economic or strategic questions that may require deeper cost-benefit analysis and/or social vulnerability considerations.

- Convene a facilitated public meeting (or Coastal Committee meeting) for the advisory group to present what they learned about the adaptation alternatives and the extent to which each alternative may address the community's priority interests and needs. Facilitate discussion of the findings to identify the communities preferred adaptation strategies.

Deliverables

- Agendas, meeting materials, and meeting summary for each meeting.

Time frame: December 2015 – March 2016

D. **Adaptation Strategy Development** – During this phase, the advisory group will prioritize preferred elements among adaptation options, including potential costs, environmental impact and regulatory barriers for each type of coastal vulnerability. The group will seek to identify specific adaptation actions, opportunities and future studies that will move the community toward resiliency to sea level rise.

Tasks

- Convene, facilitate, and document 2 – 4 additional advisory group meetings to select a suite of preferred adaptation strategies that are most appropriate for Brewster.
- Identify site-specific land use policy, zoning, and/or financial tools and architectural or engineering considerations that can be used to implement the adaptation strategies.
- Prioritize recommended strategies based on temporal urgency (whether they become critical in the near-, mid-, and long-term) and implementation potential (for example, the feasibility of a policy improvement or whether a capital investment is needed)

Deliverables

- Agendas, meeting materials, and meeting summary for each meeting.
- Assist in development of draft Coastal Adaptation Strategy Report, incorporating considerations from the vulnerability assessment and public engagement efforts.

Time frame: March - June 2016

E. **Finalize Report and Public Release:** The final phase would include synthesis, reporting, and public re-engagement. The project team, the advisory group, and the Coastal Committee will jointly release and communicate the essential messages to the greater Brewster public.

Tasks

- Work with the advisory group to draft, revise, and finalize the final adaptation strategy.
- Work with the Town of Brewster to plan and convene a final community symposium on the results of the project.
- Disseminate the final adaptation strategy document in hard copy and online.

Deliverables

- Assist finalizing Coastal Adaptation Strategy Report
- Agenda, meeting materials, and summary of public meeting

Time frame: June 2016

Consensus Building Institute, Inc. as of 6/8/2015

Draft Proposed Budget for Brewster Coastal Adaptation Strategy

LABOR	Smith $175.00	Roberts $85.00	Assistant $50.00	Phase Cost
A. Initial Scoping and Advisory Group Development				
Initial Scoping with Town Representatives and contractor project team members	4	4		
Schedule and conduct interviews with potential advisory group members	12	12	8	
Draft Recommendations, work plan, and charter	6	4		
On-going communication with Planning Team (weekly/bi-weekly check-ins)	6	6		
Plan, travel to, facilitate, and document advisory group convening meeting	12	16		
Project website development and management	4	8	16	
Sub-TOTAL	44	50	24	$ 13,150.00
B. Public Workshop				
Prepare agenda, outreach, logistics with team	3	3		
Work with technical experts to finalize materials	6	2		
Travel to and facilitate public workshop	8	8		
Prepare and implement keypad polling or other techonologies	4	8	16	
Document outcomes and follow-up on action items	2	8		
Communicate with planning team and advisory group	4	2		
Sub-TOTAL	27	31	16	$ 8,160.00
C. Alternatives Analysis				
Prepare agenda, outreach, logistics with team	3	2	2	
Work with technical experts to finalize materials	6	2		
Travel to and facilitate advisory meeting	8	8		
Document outcomes and follow-up on action items	2	8		
Communicate with planning team and advisory group	4	2		
Total Labor per advisory meeting	23	22	2	
Number of Meetings	4	4	4	
Sub-TOTAL	92	88	8	$ 23,580.00
D. Adaptation Strategy Development				
Prepare agenda, outreach, logistics with team	3	2	2	
Work with technical experts to finalize materials	6	2		
Travel to and facilitate advisory meeting	8	8		
Document outcomes and follow-up on action items	2	8		
Communicate with planning team and advisory group	4	2		
Total Labor per advisory meeting	23	22	2	
Number of Meetings	3	3	3	
Help draft Coastal Adaptation Strategy Report	12	16		
Sub-TOTAL	81	82	6	$ 21,201.00
E. Final Report and Public Release				
Work with planning team and advisory group to finalize Strategy Report	8	6		
Prepare for, travel to and facilitate public launch	12	10		
Document outcomes and action items	2	8		
Sub-TOTAL	22	24		$ 5,890.00
TOTAL LABOR				**$ 71,981.00**
DIRECT COSTS				
Car rental/mileage, 11 meetings @$100/day		$ 1,100.00		
Per Diem, 2 people with 11 travel days @ 75% of $56 each		$ 924.00		
TOTAL OTHER DIRECT COSTS				**$ 2,024.00**
TOTAL COST				**$ 74,005.00**

Horsley Witten Group
Sustainable Environmental Solutions
90 Route 6A • Sandwich, MA • 02563
Tel: 508-833-6600 • Fax: 508-833-3150 • www.horsleywitten.com

MEMORANDUM

TO: Pat Hughes, Selectman
FROM: Mark Nelson and Anne Kitchell, Horsley Witten Group, Inc.
DATE: June 12, 2015
RE: RE: SCOPE of Work for Brewster's Coastal Adaptation Plan

The Horsley Witten Group, Inc. (HW) is pleased to submit this proposed scope of work to support Brewster's grant application to the Massachusetts Executive Office of Environmental Affairs Coastal Community Resilience Grant for the development of a Coastal Adaptation plan.

Under this proposal, the Town of Brewster and its consultants (the Project Team) will develop a vulnerability and risk assessment associated with climate change. The technical component of the work will include five major work areas.

1. Mapping and evaluation of the natural systems along Brewster's coast to understand the shoreline under future conditions with continued shoreline erosion, sea level rise (SLR) and storm surge that can impact areas further inland. This will include the use of visualization tools and graphics that will help Town residents and other stakeholders understand the future of the Town's shoreline and the impacts of climate change.
2. Developing maps and visualization products to identify the extent to which public and private development and associated infrastructure will be impacted by climate change.
3. Identification of opportunities to adapt to future conditions through retreat strategies, wetland migration, regulations on future development, retrofits of existing properties and structures, such as the ongoing Breakwater Landing parking lot retreat and dune restoration, and other appropriate strategies. Like Breakwater Landing many of the Town's access points to the beach on Cape Cod Bay are threatened by coastal erosion, and there are limited opportunities to move parking facilities further from the coast. Therefore opportunities for remote parking and shuttle services will be analyzed.
4. Development of the Town's Coastal Adaptation Strategy describing the proposed strategies and how they will be implemented across Brewster, including potential updates to Brewster's Local Comprehensive Plan.
5. A comprehensive public involvement process to translate this information to Town officials and the general public in a way that allows the community to select adaptation approaches to protect its coastal areas.

Further detail on how HW will support this work is provided below. Please note that we have included Stan Humphries, a Coastal Geologist with LEC Environmental Consultants as a member of our team.

Task 1. Analysis of Coastal Erosion Data and Prediction of the Future Coastline

Under a previous grant, the Center for Coastal Studies has analyzed sediment transport along Brewster's Cape Cod Bay shoreline and estimated the areas where erosion is occurring and where sediment deposition is taking place. This data will be used along with the existing shoreline change mapping to predict the extent of erosion along the coast over the foreseeable future. Data from ongoing private beach nourishment projects will be gathered and evaluated to determine how significant these sediment additions are, both now, and in the future. The exact timing for the erosion predictions will be based on the analysis of the available data, and it is anticipated that two shoreline erosion scenarios will be developed. The timing of the erosion simulations will likely be consistent with those used for mapping SLR and this will be discussed through the stakeholder process.

Estimated Cost: $11,060

Task 2. Identification of tidal, sea level rise, and storm surge parameters

HW will identify tidal, SLR, and storm surge scenarios for short and long term planning horizons (e.g., 25 year and 50 year) to be evaluated for this project. This will include two global mean sea level rise scenarios as published in the *NOAA Technical Report Global Sea Level Rise Scenarios for the United States National Climate Assessment* (December, 2012). The Project team will also consider other local or relative SLR projections such as those available in the U.S. Environmental Protection Agency's CREAT application (Climate Resilience Evaluation and Awareness Tool) and those discussed in Mass CZM's 2013 report *Sea Level Rise: Understanding and Applying Trends and Future Scenarios for Analysis and Planning* . Options for SLR scenarios will be discussed and agreed upon with the Brewster Coastal Advisory Group (BCAG).

Estimated Cost: $10,100

Task 3. Erosion, SLR, and Storm Surge Mapping

HW will create maps showing the inland progression of shoreline erosion based on the information developed in Task 1. HW will also develop sea level rise projection/inundation maps for three SLR projection scenarios at two time periods for the entire Brewster coastline.

To develop these maps, the Project team will make use of available LiDAR (Light Detection and Ranging) data that HW, on behalf of the Town, has already translated and incorporated into past projects for the Integrated Water Resource Management Plan. To further understand impacts from storm surge events, the Team will utilize the results of Sea, Lake, and Overland Surges from Hurricanes (SLOSH) modeling (performed by the Commonwealth of Massachusetts) to create maps and 3-D renderings.

In addition to Town-scale maps illustrating inundation from SLR and storm surge scenarios, two site-specific maps will be prepared to demonstrate shoreline erosion and SLR inundation impacts at a more focused scale. The goal will be to focus on specific vulnerable areas of concern, such

as at one of the public beach landings and within a tributary salt marsh, and illustrate potential inundation conditions in varying environments in Brewster. For each of these specific areas, the Project Team will also create one photographic rendering in addition to a static GIS-based map.

Estimated Cost: $10,400

Task 4. 3D SLR and Storm Surge Animation/Visualizations Under Future Erosion Conditions

HW will utilize the most current technologies to create 3D photographic renderings illustrating SLR and storm surge along the Brewster shoreline. Using Oblique 3D images from Google Earth Pro and Bing Bird's Eye View, as well as Autodesk Infraworks and other infrastructure visualization technologies an animation for a portion of the Brewster coastline will be prepared to illustrate current and future conditions using selected erosion, SLR and storm surge scenarios.

The site-specific maps, photographic renderings, and 3D visualization will play a critical role in community outreach and education on the subject of climate vulnerability. A picture is indeed worth a thousand words when communicating technically complicated topics to the general public.

In addition to the proposed graphics that will illustrate future climate scenarios, existing information will be gathered to demonstrate to the public how climate change may impact the community. Each year there is a "King Tide," the highest astronomical tide of the year.

Capturing photos of this tide demonstrates what a "normal" high tide will be at a future date as SLR occurs. An example comparison of a King Tide to a normal high tide in Sandwich, Massachusetts, is shown here to demonstrate how the King Tide photos can be useful for public education. The demonstration here of a low lying house adjacent to a marsh is also applicable to Brewster and such photos help bring home the message of climate change quite clearly.

Town Neck at King Tide

Town Neck at normal high tide

Finally, the Project Team will incorporate existing data on how groundwater levels near the coast will respond to SLR. Under the Town's Integrated Water Resource Management Plan, the areas where SLR could impact the functionality of septic systems were identified based on estimated changes in groundwater levels near the coast. Since then, the U.S. Geological Survey has developed a model for all of Cape Cod predicted water levels under SLR scenarios. Data from both projects will be used to update the analysis of showing the number of onsite systems that will be impacted by rising groundwater levels. HW, one of the proposed consultants for this project, is working with EPA Region 1 to assess onsite system impacts from climate change. It is anticipated that information developed from this project, to be completed early 2016, can be incorporated into the Town's Coastal Adaptation Strategy.

Estimated Cost: $10,030

Task 5. Identification of Vulnerable Natural Resources and Built Infrastructure

HW will use the data and maps created in Tasks 1-4 with additional data obtained from the Town' GIS database (e.g., land use, natural resources, parcels, public works), and data and analyses completed by Brewster in its 2014 coastal community resiliency grant, to identify the degree to which infrastructure and natural resources are vulnerable relative to the estimated levels of erosion and SLR.

HW will inventory and assess the existing condition of public infrastructure and natural and recreational resources that would be impacted by the various inundation scenarios. Public infrastructure of interest includes, but is not limited to: Town landings providing public access to the beach; scenic roads used for walking and biking; drainage systems, roads; utilities; and critical facilities. Natural resources include, but are not limited to: open space, beaches, banks, salt marshes, ponds, parks, and conservation land.

HW will also quantify the number of private buildings and associated onsite septic systems that are at risk based on the mapping and vulnerability analysis. A matrix will be developed to rank those risks to assets based on risk and vulnerability criteria that are deemed to be important. These criteria may include:

- Elevation above predicted flood stages
- Proximity to future shoreline based on predicted erosion rates
- Estimated replacement costs based on order of magnitude
- Assessor's valuation
- Public access considerations (especially for Town Landings)
- Age
- Habitat value
- Public health and safety value

These criteria will be finalized as data is developed and will be weighted and a scoring system will be developed to prioritize those assets for adaptation and mitigation efforts.

Estimated Cost: $3,150

Task 6. Development of Adaptation Strategies

HW will develop recommendations for adaptation strategies relative to vulnerable infrastructure and resources based on the vulnerability assessment tasks described above.

These adaptation strategies will prioritize short, mid, and long-term implementation potential and will be derived from a number of sources. For example, the Team will likely use information from the following regional reports: *Massachusetts Climate Change Adaptation Report* and *Sea Level Rise: Understanding and Applying Trends and Future Scenarios for Analysis and Planning,* and resources from CZM's StormSmart Coasts. In addition, the Project Team will reference the U.S. EPA's Adaptation Strategies Guide for Water Utilities, published in 2013, to determine options for mitigating risks to water and stormwater infrastructure, as well as NOAA's report *Incorporating Sea Level Rise at the Local Level* (2012). Green engineering options may be suggested, as well as options to move or elevate infrastructure assets or to purchase and protect additional key resource areas. Coastal wetlands, and particularly salt marshes, are especially vulnerable to SLR. These vital resources contribute to flood control in addition to providing habitat and improving water quality.

HW will examine adaptation options based on a do-nothing, straight-line projection from historic conditions, and a predicted conditions context considering both the short and long term planning horizons.

Examples include:

- Improvements to coastal wetlands and estuaries to better capture and withstand extreme flooding events. This may include developing areas for inland migration of wetlands or thin-layer deposition of appropriate dredge materials on the surface of salt marshes to help avoid inundation under SLR, an approach currently being considered in Rhode Island.
- Redevelopment of Town landings to remove pavement in appropriate areas, upgrade stormwater infrastructure, and build appropriate sand dunes to help minimize storm damage in the future.
- Evaluation of a remote parking and shuttle bus program to replace parking potentially lost at Town landings to continue to provide public access to the coast.
- Recommendations for local zoning bylaw changes to encourage development in areas not directly impacted by SLR. This could include a floodplain management bylaw based on the Cape Cod Commission's model ordinance.
- Development of public education materials for property owners whose septic systems will be impacted by erosion or SLR by providing information on how they can upgrade their system so that it remains functional and in compliance with the State Environment Code, Title 5.
- Consideration of a transfer of development rights (TDR) bylaws to encourage redevelopment away from threatened areas.
- Recommendations to upgrade the current water infrastructure and what may need to be upgraded or moved to accommodate erosion, SLR and future storm surges.
- Changes in seawalls and other hardened structures to accommodate a higher sea level.

- Improvements to existing stormwater management facilities to better handle large storms and flooding events.

HW will categorize adaptation strategies into three general categories to assist in developing the Coastal Adaptation Strategy.

- **No Regrets** - many options may provide benefits under current conditions and potential future erosion, SLR and coastal surge conditions. These options provide other, more immediate, economic, environmental, or social benefits regardless of future conditions. They are not necessarily cost free.
- **Low Regrets** - provide benefits particularly if erosion, SLR and coastal surge projections become reality.
- **Climate Justified** - actions that reduce greenhouse gas emissions and provide co-benefits (e.g., energy efficiency, energy stability/resilience, optimization and reduced operating costs).

All adaptation options will also be further characterized by order of magnitude costs. For example, planning strategies tend to be relatively less costly than operational and capital strategies. As such, some planning options, such as holding regular discussions on climate adaptation at Town meetings, might be noted with one dollar sign ($), while moving critical infrastructure out of areas potentially impacted by SLR would be noted with three dollar signs ($$$).

A matrix of adaptation options will be presented to the Brewster Advisory Group for review and discussion. An updated version will then be created based on the outcome of these discussions, and used in the final report and the implementation plan discussing proposed next steps for the Town and associated stakeholders.

Estimated Cost: $14,115

Task 7. Draft and Final Coastal Adaptation Strategy

HW will prepare a summary report describing the work undertaken in this project and the recommendations for potential adaptation strategies. The report will describe data sources, assessment methodologies, maps, vulnerable/impacted assets, potential adaptation options, and the options' relative costs and benefits. An executive summary will be provided along with a recommended implementation plan showing a schedule for when proposed actions will be implemented. A draft report will be prepared for review and comment by town residents and other stakeholder organizations. Following receipt of comments and after discussions with the Brewster Coastal Advisory Group, a final report will be prepared.

Estimated Cost: $7,480

Task 8: Meetings

The technical consultants will participate in the public meeting with the Brewster Coastal Advisory Group to provide input on the data collected for the vulnerability assessment and to present the results of the erosion, SLR and storm surge analyses. HW will also solicit input on the proposed adaptation strategies developed in Task 6.

Estimated Cost:	$16,850
Total Estimated Cost:	$83,185

2	8	10		30	0	40		200	*290*	$10,100.00
8		12		10	32	20	10	200	*292*	$10,400.00
4		8		12	32	40	4	250	*350*	$10,030.00
6	12								*18*	$3,150.00
16	4	40	15	24	10	5	8	300	*422*	$14,115.00
12	6	16			8	20		350	*62*	$7,480.00
46		40					24	200	*110*	$16,850.00
98	30	126	15	88	98	125	86		*580*	
$17,150	*$5,250*	*$13,860*	*$1,650*	*$11,880*	*$8,820*	*$9,375*	*$15,050*	*$1,800*		
									TOTAL COSTS:	$83,185

Horsley Witten Group
Sustainable Environmental Solutions
90 Route 6A • Sandwich, MA • 02563
Tel: 508-833-6600 • Fax: 508-833-3150 • www.horsleywitten.com

April 30, 2015

See Task 2

Susan M. Leven
Town Planner
Brewster Town Hall
2198 Main Street
Brewster, MA 02631

RE: Revised Scope of Work for Implementation Phase of Brewster's Integrated Water Resource Management Plan

Dear Ms. Leven:

On behalf of the Horsley Witten Group, Inc. (HW), I am pleased to submit this revised scope of work to continue our firm's work with the Town of Brewster to implement the recommendations from the Integrated Water Resource Management Plan (IWRMP). This scope of work includes three additional planning tasks as part of the IWRMP and a series of implementation tasks based on the IWRMP's recommendations. These include work to begin implementation of Alternatives Analysis report for the Pleasant Bay watershed and tasks related to the proposed septic system and stormwater regulations. Further work is also included to prepare for the restoration of the Mill Ponds complex. Finally, ongoing tasks for public involvement and outreach are included.

The following planning tasks are proposed:

Task 1: Mitigating Nitrogen Impacts from Future Development in the Pleasant Bay, Herring River and Cape Cod Bay Watersheds

HW will prepare an evaluation of the water quality issues associated with the Cape Cod Bay watershed, the largest watershed area in Brewster. This will include a description of the septic system and stormwater issues in this portion of town and how the implementation of the IWRMP will support water quality protection for Cape Cod Bay and its tributaries. Much of the information needed to prepare this evaluation is available from the earlier phases of the IWRMP. HW will also develop a suite of potential strategies for mitigating the nitrogen loading impacts from future development in the Pleasant Bay and Herring River Watersheds. Options will be evaluated for the development of commercial lots, residential subdivisions and for individual residential lots. Potential options will be presented to the Town for consideration. The selected options will be presented in a report that will document the steps needed for implementation.

Three meetings with Town staff and/or Committees will be held to discuss the findings from the analysis.

Estimated Cost: *$8,180*

Task 2: Management Plan for Septic Systems in Marginal Areas

In past phases of the IWRMP the number of lots with onsite systems in marginal areas has been quantified. These include systems affected by tight soils, shallow depths to groundwater and, for a few properties, increases in groundwater levels resulting from sea level rise. HW will prepare a summary of options available for property owners that have onsite systems in marginal areas to assist them as they plan for a system upgrade. HW work also with the Town to determine if additional regulation of septic system designs in these areas is needed, and, if so, what changes to the existing Health Regulations are needed to improve onsite system management in these areas. Options may include regular septic system inspections and/or leaching facility design specifications to support infiltration in marginal areas. A brief letter report will be prepared summarizing the findings and recommendations of the analysis and any steps needed to implement what is proposed.

Estimated Cost: *$7,970*

In addition, the following implementation tasks are provided:

Task 3: Implementation of Golf Course Nitrogen Reduction Methods

HW will assist the Town and the Golf Course Superintendent in setting up the process to document and report annual nitrogen reductions associated with reduced fertilizer applications and the uptake of nitrogen through the golf course irrigation well. Please note this task does not take the place of the ongoing monitoring of groundwater and irrigation water quality at the golf course.

HW will prepare forms for the golf course to use annually to document fertilizer usage, and therefore the nitrogen reduction from applications used on the calculation of the Pleasant Bay Total Maximum Daily Load (TMDL). HW will also provide a spreadsheet and reporting form to document the amount of nitrogen recaptured by the irrigation well based on annual water quality data. One to two meetings with the Golf Course Superintendent will be held to discuss the future use of the materials developed by HW.

Estimated Cost: *$3,250*

Task 4: Coordination with Neighboring Towns

HW will work with the Town to evaluate potential regional solutions to water quality issues in Pleasant Bay and other shared watersheds. This will build on the shellfish whitepaper developed in Task 1 and may also include evaluation of nitrogen loading issues in Namskaket Marsh, and other non-traditional nitrogen reduction methods proposed for Pleasant Bay, such as a permeable reactive barrier or floating islands. HW will participate in initial discussions with Brewster and neighboring towns, including the Pleasant Bay Alliance, on the issues of waste management agencies as discussed in the Cape Cod Commission's 208 Water Quality Management Plan Update. Up to six meetings are included with this task, along with the research and analysis of potential regional solutions.

Estimated Cost: *$10,300*

Task 5: Planning and Permitting to Implement the Mill Ponds Management Plan

Additional funding is requested to begin the implementation of the management plan recommendations for the Mill Ponds Complex. This includes the following:

- Outreach to Town Boards on the recommendations in the management plan, the process to restore the ponds and the costs required. This will include two meetings with Town Boards, such as the Board of Selectmen, and the preparation of a brochure and/or web page describing the restoration process.

- Development of a Notice of Project Review for submission to the Natural Heritage and Endangered Species Program (NHESP) to request approval for the proposed restoration plans. NHESP has jurisdiction over the project because of the presence of rare fresh water mussels in the ponds. HW will prepare the project review application and hold two meetings with NHESP staff and the Town to discuss the project.

- Development of a Notice of Intent (NOI) to the Brewster Conservation Commission to request their approval to move forward with the project. The NOI will describe the work to be completed in each pond and the water quality improvements that are expected. HW will attend three meetings with the Commission to discuss the project.

- Identification of grants or other funding opportunities to support the cost of the restoration plan.

Ed Eichnor with the University of Massachusetts School of Marine Science and Technology will assist with the permitting process given his role in developing the management plan.
The outcome of this task will include the two permit applications and three Conservation

Commission hearings on the project. There may need to be additional work to complete the permitting process based on the outcome of these two permitting efforts. If so, HW will provide a scope and cost estimate for any additional work.

Estimated Cost: *$22,150*

Task 6: Stormwater Management By-law and Regulations

HW will continue its work to finalize the stormwater management bylaw and associated regulations. This will include final edits to the materials based on input from the Town, and presentations at Planning Board meetings and hearings regarding the adoption of the regulations. HW will also update the existing fact sheet about the proposed regulations and develop two to three other public outreach materials at the direction of the town. These could include a newspaper press release or editorial, a videotaped interview for broadcast on the local cable channel or materials for the project web site. Three meetings with the Planning Board are included with this task.

Estimated Cost: *$10,690*

Task 7: Proposed Board of Health Regulation

HW will finalize the proposed Board of Health regulation based on input from the Town and will attend up to three Board of Health meetings or hearings on the regulation. A fact sheet on the proposed regulation and how it impacts property owners near fresh water ponds will be prepared.

Estimated Cost: *$5,620*

Task 8: Outreach and Coordination on Pond Restoration and Other IWRMP Activities

HW will provide the following support for ongoing outreach and educational activities:

- Ongoing updates to the project website regarding new products or new activities undertaken by the Town;
- Development of outreach materials related to the recently adopted fertilizer bylaw, including a brochure for residents and commercial property owners, and a write-up for the Town's website;
- Development of a Pond Restoration brochure describing the steps needed to evaluate existing water quality in a pond, the techniques used to restorer water quality and permitting requirements to implement restoration actions; and

- Two public meetings to discuss pond restoration and/or the implementation of the Pleasant Bay nitrogen reduction alternatives.

Estimated Cost: *$8,760*

Task 9: Meetings
HW will attend up to five additional meetings at the request of the town to support the activities included within this scope of work.

Estimated Cost: *$5,600*

Total Estimated Cost: $82,520

HW is prepared to begin this work upon your authorization to proceed. We believe this work can be completed by December 2015 and HW will work with you to finalize a mutually acceptable project schedule.

Thank you again for the opportunity to work with the Town of Brewster, and please let me know if you have any questions about this scope of work.

Sincerely,

HORSLEY WITTEN GROUP, INC.

Mark E. Nelson, P.G.
Principal

Enclosure

ACKNOWLEDGED AND APPROVED:

Charles L. Sumner
Name

Town Administrator
Title

5.11.15
Date

Certifying appropriation
Lisa Soucie finance director
A.35 Tm 11/14 Water Resource Mgmt Plan
A.35 Tm 11/13 Water Resource Mgmt Plan

APCC
Association to
Preserve Cape Cod

June 11, 2015

Ms. Patricia Bowie
Coastal Resiliency Specialist
Massachusetts Office of Coastal Zone Management
251 Causeway Street, Suite 800
Boston, MA 02114

Re: Letter of Support for Town of Brewster Proposal
"Building a Coastal Adaptation Strategy in Brewster"
FY16 CZM Coastal Community Resilience Grant Program

Dear Ms. Bowie:

On behalf of the Association to Preserve Cape Cod (APCC), I am pleased to provide this letter expressing our strong support for the Town of Brewster's proposal to develop a consensus-based coastal adaptation strategy for the town. Over the years Brewster has proven to be a leader in environmental protection and restoration measures, and their success in implementing a managed retreat project at Paines Creek Beach served as a model for other coastal communities. As with many environmental issues, it is often community consensus that drives action. This proposal will provide a valuable model for developing community consensus on the need for coastal adaptation planning and implementation.

APCC was founded in 1968 to promote policies and programs that enhance the protection of the natural resources of Cape Cod. APCC is the Cape's largest environmental organization and has 5,000 members from all 15 towns on Cape Cod. In our 47 years, we have successfully advocated for protection of the Cape's water resources, open space, and natural resources and the adoption of regional growth management policies. In 2012 we initiated several coastal resilience programs, including evaluation of the effect of sea level rise on the mid-Cape's groundwater system, partnering with Brewster, Provincetown, and other towns to promote coastal resilience of communities and ecosystems, identifying sensitive natural communities, and participating in a state-wide climate change adaptation working group promoting preparedness planning at the state level. We are developing a Cape-wide inventory of more than 100 coastal restoration projects (e.g., tidal restrictions, fish runs, stormwater) and are evaluating which projects can serve to increase coastal resilience. For more on our programs, visit http://www.apcc.org/ .

APCC is also the regional service provider for the Cape Cod region of the Massachusetts Bays National Estuary Program, whose mission is to facilitate partnerships to protect and restore healthy and resilient estuaries and sustainable ecosystems that support the life and communities dependent upon them (http://www.mass.gov/eea/agencies/mass-bays-program/). APCC's Senior Scientist, Dr. Jo Ann Muramoto, is the MassBays regional coordinator for Cape Cod and provides technical assistance, outreach and facilitation to help communities improve and protect the Bays water quality and coastal habitat. Since 2006 she has been assisting the Town of Brewster with a number of coastal restoration projects and is familiar with the environmental issues and community.

3010 Main Street, P.O. Box 398, Barnstable, MA 02630-0398
Ph: 508-362-4226 Email: info@apcc.org Website: www.apcc.org
A non-profit organization. Dues and contributions tax-deductible as provided by law.

This letter also serves to describe our commitment to providing in-kind match for this project. We propose to provide in-kind match for the following activities:

- Identify at-risk natural communities in Brewster's coastal zone, building on an ongoing project to map natural communities by relating the type and sensitivity of natural communities to threats posed by shoreline change and sea level rise. This work began in June and will continue through 2016. This project is funded by a private grant from the Eddy Foundation of Brewster awarded to APCC in November 2014. Proposed match: $5,000 of in-kind services.

- Identify potential coastal restoration projects that could improve coastal resilience of communities and ecosystems in Brewster. To date, we have identified nearly a dozen coastal restoration projects involving stormwater or altered coastal watershed hydrology (e.g., Consodine Ditch). We will evaluate which restoration projects may be useful for increasing coastal resilience. APCC has applied for funding to support development of the inventory of coastal restoration projects. Anticipated match: $2,500 of in-kind services.

- Assist with outreach as needed by the Town and its partners (e.g., newsletter articles, press releases, meeting notes, etc.). Proposed match: $1,500 of in-kind services. This match will be provided by the MassBays Program's regional coordinator for the Cape Cod region.

- Assist the Town with project management (e.g., review of scope and deliverables, reporting, grant-writing). Proposed match: $1,000 of in-kind services. This match will be provided by the MassBays Program's regional coordinator for the Cape Cod region.

Total proposed match: $10,000 of in-kind services.

Thank you for considering Brewster's innovative community-based project. We urge you to support this important proposal.

Sincerely,

Edward J. DeWitt
Executive Director

ED/jm

3010 Main Street, P.O. Box 398, Barnstable, MA 02630-0398
Ph: 508-362-4226 Email: info@apcc.org Website: www.apcc.org
A non-profit organization. Dues and contributions tax-deductible as provided by law.

3225 MAIN STREET • P.O. BOX 226
BARNSTABLE, MASSACHUSETTS 02630

(508) 362-3828 • Fax (508) 362-3136 • www.capecodcommission.org

CAPE COD
COMMISSION

June 12, 2015

Patricia Bowie, Coastal Resilience Specialist
Massachusetts Office of Coastal Zone Management
251 Causeway Street, Suite 800
Boston, MA 02114

RE: Letter of Support for Town of Brewster's proposal to conduct a facilitated Coastal Adaptation Strategy

Dear Ms. Bowie:

The Cape Cod Commission is pleased to partner with the Town of Brewster under the Coastal Zone Management Coastal Community Resilience Grant Program to develop a consensus-based coastal adaptation strategy to advance understanding of Brewster's coastal change and erosion issues. We believe that the work Brewster proposes through this grant will have significant transferability to other communities in the region.

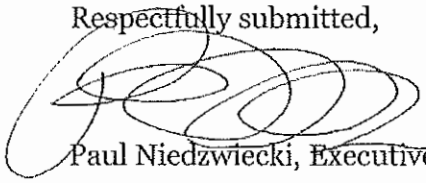
The Cape Cod Commission will commit to Brewster's Coastal Adaptation Strategy proposal by providing in-kind planning services from key personnel to complete the project by the June 2016 time frame. We commit to provide between 60 – 80 hours, with a value of between $4,500 - $6,200, to assist the town with the following tasks:

1. Work with town boards to evaluate floodplain regulations, and recommend changes, utilizing the Cape Cod Commission's *Model Bylaw for Effectively Managing Coastal Floodplain Development*, as appropriate
2. Participate in the proposed BCAG and BCC facilitated meetings to analyze adaptation needs and identify adaptation strategies for Brewster
3. Support the transfer of lessons learned from the facilitated process in Brewster to other Cape communities, including through hosting the project website on the Commission's website; conducting outreach to other Cape

communities; and presenting results at regional forums and meetings (e.g. Cape Coastal Conference), as opportunities arise.

Thank you for the opportunity to submit this grant proposal.

Respectfully submitted,



Paul Niedzwiecki, Executive Director

Cc: Elizabeth Taylor, Brewster CCC Representative

The Center will work with the Town's consultants on the Vulnerability Asse
public meeting for a total cost of: $2,283.36.

Let me know if you have any questions, Thanks Mark

Mark Borrelli, Ph.D.
Coastal Geologist
Associate Scientist, Director
Seafloor Mapping Program
Center for Coastal Studies
Hiebert Marine Lab
5 Holway Avenue
Provincetown, MA 02657 USA

Research Faculty
University of Massachusetts, Boston

office: 508.487.3623 x117
mobile: 508.808.9418
fax: 508.487.4695
mborrelli@coastalstudies.org

Town of Brewster
Department of Natural Resources
2198 Main Street
Brewster, Massachusetts 02631-1898
(508) 896-3701

Mr. Chris Miller, Director, Department of Natural Resources and Conservation, Town of Brewster

Proposed role: Project Manager/Team Leader and staff support to the Brewster Coastal Committee and Brewster Coastal Advisory Group.

Qualifications:

Mr. Miller has a B.S. in Wildlife and Fisheries Biology from the University of Massachusetts, and an M.S. in Chemical Engineering from Wayne State University.

Mr. Miller has a diverse background with 24 years of experience in environmental consulting, technical consulting, wildlife biology, and municipal service as a department head. He is a member of the Stony Brook Salt Marsh Restoration Project Team that was awarded one of 50 NOAA-ARRA coastal restoration grants in 2009. In 2011 he was given a Coastal America Partnership award in for the Stony Brook restoration project and NOAA's Excellence in Restoration Award. In 2013 the Brewster Conservation Trust selected the Brewster Department of Natural Resources as its Conservationists of the Year.

Chris, his department staff and their volunteer group of 150 people will be closely involved in the proposed project. Chris was the Project Manager for the Route 6a culvert replacement project, the Freemans Pond culvert replacement project, and the Stony Brook Mill Dam Rehabilitation project, all of which occurred simultaneously with multiple engineering firms and contractors, including federal reporting to NOAA and NRCS.

Jo Ann Muramoto, Ph.D.

EDUCATION

Ph.D., Geological Sciences, 1992, Cornell University, Ithaca, NY (minors in Microbiology, Environmental Quality). Ph.D. Thesis Title: "Studies of Sulfur Biogeochemistry, Microbiology and Paleontology in Three Anoxic Environments: The Black Sea, A Salt Marsh Mat, and an Ordovician Black Shale".

B.S., Biology, 1977, California Institute of Technology, Pasadena, CA

PROFESSIONAL EXPERIENCE

Senior Scientist, Association to Preserve Cape Cod (APCC) and Massachusetts Bays Program (MBP) Regional Coordinator for Cape Cod, July 2006 – present. Works with Cape Cod communities to preserve and restore coastal ecosystems and implement the Comprehensive Conservation Management Plan for Cape Cod and Massachusetts Bays. Goals include restoration of coastal habitat, improving water quality and building local capacity. Responsibilities include providing technical assistance (e.g., project management, coordination, grant-writing), monitoring restoration sites, providing outreach and presentations, and assisting the Barnstable County Coastal Resources Committee, the County's coastal advisory committee and local governance committee for the MBP Cape Cod region.

Senior Project Manager and Coastal and Wetlands Division Director, Horsley Witten Group, 1999 – July 2006. Senior project manager at an environmental firm, specializing in coastal and ocean issues, drinking water protection, water and sediment chemistry, risk assessment, statistical analysis, environmental assessment, permitting, and information transfer, and QA/QC. Responsibilities included project management, proposal writing, corporate QA/QC, technical writing, and staff supervision.

Conservation Administrator, Town of Falmouth, MA, 1995 – 1999. Administered state and local wetland regulations, reviewed permit applications, wrote wetland permits, advised Conservation Commission, applicants and the public concerning wetland regulations, provided litigation support, conducted enforcement, prepared land management plans, and supervised the Conservation department.

Senior Biogeochemist, ENSR Marine Sciences, 89 Water Street, Woods Hole, MA 1995. Conducted monitoring of sediment and water quality at ocean disposal sites (e.g., Boston Harbor sewage outfall in Massachusetts Bay), evaluated data, and prepared reports and proposals.

Biogeochemist, Science Applications International Corporation (SAIC), 89 Water Street, Woods Hole, MA, 1990 - 1994. Monitored sediment and water quality at ocean disposal sites in New York Bight and the Farallon Islands Navy Disposal Site, participated in oceanographic cruises, performed statistical analyses, assisted with R&D of instrumentation for monitoring polyaromatic hydrocarbons, and prepared reports, permit applications and proposals.

Postdoctoral Investigator, Geology and Geophysics Department, Woods Hole Oceanographic Institution, 1992 - 1993. Conducted research in Black Sea sulfur biogeochemistry, participated in oceanographic cruises, and prepared reports, literature reviews, scientific articles and proposals.

Graduate Research Assistant and Teaching Assistant, Cornell University, Geology Department, 1982 - 1990. Conducted doctoral research in sulfur biogeochemistry and microbiology in the Black Sea, wrote proposals and scientific papers, and taught Historical Geology. Guest Student at the Woods Hole Oceanographic Institution, Geology and Geophysics Department.

Mineralogy Consultant, Jet Propulsion Laboratory, California Institute of Technology, 1982. Analyzed meteorites using electron microscopy and microprobe to help determine their origin and age.

Post-graduate student, University of Southern California, 1981-1982. Attended post-graduate courses in trace fossils, mineralogy, and paleontology.

Graduate Research Assistant, Zoology Department, Australian National University, Canberra, Australia, 1979 - 1980. Conducted research in biogeographic variation of lizards (Scincidae) in New South Wales, Australia, involving field trapping and studies of morphology and animal behavior.

Research Assistant, Geology Department, California Institute of Technology, 1977 - 1978. Analyzed biomineralization in marine organisms using SEM, x-ray diffraction, and spectrophotometry.

REPRESENTATIVE WORK IN PAST 10 YEARS

Restoration of Stony Brook Salt Marsh, Freeman's Pond Salt Marsh and Lower Mill Pond Fish Passage, Brewster, 2006 to 2013. Assisted Town of Brewster with project development, project management, grant-writing, and monitoring to restore 41 acres of salt marsh and fish passage to 386 acres of spawning area. Monitoring includes tidal studies, herring counts, and monitoring of water level, Phragmites, rare species and salt marsh. Restoration of Stony Brook occurred in November 2010; restoration of fish passage to Lower Mill Pond occurred in Fall 2012; and restoration of Freeman's Pond was completed in Fall 2013. Total grants from agencies: $1,647,900 from NOAA and the American Recovery and Reinvestment Act of 2009 and $58,600 from the Gulf of Maine Council and NOAA.

Technical assistance to Cape Cod municipalities and organizations, 2006 – ongoing. Provided direct grant-writing assistance to towns and organizations to obtain $2.2 million in grants for coastal restoration, stormwater, pumpouts, outreach, climate change adaptation, and applied research, and helped to obtain an additional $7.6 million in grants by providing other support. Assisted with project development and project management. Clients included towns (Brewster, Sandwich, Dennis, Yarmouth, Provincetown, Orleans, Wellfleet, and Falmouth), and organizations (Provincetown Center for Coastal Studies, Friends of Herring River, Wellfleet Audubon Sanctuary, and Cape Cod Commercial Hook Fishermen's Association).

Evaluating Impacts of Sea Level Rise on a Coastal Aquifer, 2012 – ongoing. In this climate change adaptation project, the U.S. Geological Survey will model the response of the mid-Cape's groundwater system to sea level rise in order to predict impacts of sea level rise on the elevation of the water table, changes in stream hydrology and baseflow, and the position of the saltwater-freshwater interface below Cape Cod. APCC and the Cape Cod Commission will develop outreach and policy tools based on the USGS model and findings. The project will provide science-based risk information on the effects of sea level rise on the Cape's groundwater system to inform public water suppliers, wastewater and

stormwater managers, natural resource managers, and community planners. Project responsibilities include science translation into outreach materials, grant-writing and project management.

Review of Pilgrim Nuclear Power Plant impacts on Cape Cod, 2013. At the request of the APCC Board of Directors, the environmental impacts of Pilgrim were reviewed to identify potential risks to Cape Cod's environment. The findings were used to prepare a position statement for the Board.

Restoration of Fish Passage to Upper Shawme Lake, Sandwich, 2008 to 2013. Assisted the Town of Sandwich Natural Resources Department with grant-writing, grant management, and monitoring of a new fish ladder to Upper Shawme Lake which will restore anadromous fish passage to a 20-acre pond. Helped the Town to obtain $78,000+ in grants to replace the fish ladder. Ongoing activities include coordinating a volunteer herring count program to document the return of herring following restoration.

Barnstable County Coastal Resources Committee (CRC), 2007 – ongoing. Helped re-establish the CRC as a coastal advisory committee to the County and towns and as the local governance committee for the Mass Bays Program. The CRC is the liaison between the County and the 15 towns on Cape Cod on coastal issues. Members include representatives from all 15 towns on Cape Cod, and regional, state and federal agencies. Responsibilities include staffing and coordination. CRC activities include recommendation of projects for the NRCS Cape Cod Water Resources Restoration Project, and outreach workshops (e.g., role of shellfish in nitrogen uptake, stormwater utilities).

Mayo Creek Salt Marsh Restoration Feasibility Study, Wellfleet, 2009 – 2010. Assisted the Town of Wellfleet Conservation Department with grant-writing, grant management, project management and monitoring for a salt marsh restoration feasibility study to restore 25 acres of impaired salt marsh.

No Discharge Area designations for Cape Cod Bay, Nantucket Sound and Vineyard Sounds, 2006 – 2011. Assisted CZM in designating these waters as federal No Discharge Areas (NDAs) for boat sewage. Responsibilities included preparing an NDA application and outreach materials, collecting data, and grant-writing. Obtained a $10,000 Action Grant from the Gulf of Maine Council for outreach.

Stormwater Utility Outreach Program For Cape Cod Municipalities, July 2006 – ongoing. Provided Cape Cod communities with outreach on financing options for stormwater management, including stormwater utilities. Outreach included workshops, meetings, outreach materials, articles and website. Work resulted in one town conducting a pre-feasibility study for stormwater utilities, and generated interest in the Buzzards Bay watershed. Award amount: $40,000.

Assessment of Stormwater Drainage and Stormwater Pollutants in Paines Creek and Stony Brook Watershed, Brewster, MA, 2007. Helped the Town of Brewster DPW to prepare a proposal to the MA CZM Nonpoint Source Program to evaluate stormwater discharges into the Stony Brook watershed. This assessment supported four subsequent remediation projects, and serves as a model for a watershed approach to stormwater management. Award amount: $19,150.

Citizen Monitoring of Fish Runs, 2006 to present. This program builds citizen support for restoration of fish runs by engaging volunteers in monitoring fish runs. Data are used by state and federal fisheries managers for fisheries management. Helped set up volunteer count programs in nine towns and 12 runs. Responsibilities include coordination of volunteers, data management, reporting, and outreach.

Technical Writer/Editor, EPA Water Security Training Tools, U.S. EPA Office of Ground Water and Drinking Water, 2002 - 2006. Wrote and edited water security guidance documents, technical reports, and fact sheets for water and wastewater suppliers (e.g., *Handbook of Water Security, Response Protocol Toolbox for Water Contamination Threats and Incidents*, others). Contract value: $350,000.

Assessment of Relative Risks of Wastewater Management Options for South Florida, U.S. EPA, Office of Ground Water and Drinking Water, 1999 - 2003. Helped manage a study, mandated by Congress in 2000, to evaluate the human health and ecological risks of disposal of treated wastewater in South Florida via ocean outfalls, Class I deep injection wells, surface water discharge, and aquifer recharge. Responsibilities included project management, designing a relative risk methodology, collecting data, reviewing literature, conducting the risk assessment, preparing reports and presentations, and providing quality assurance. Contract value: $600,000.

ORGANIZATIONS, COMMITTEES

Mass Bays Program, Science and Technical Advisory Subcommittee, 2013
Sigma Xi Scientific Society, member
Association to Preserve Cape Cod, member (former member, Board of Directors, 1995-1996)
Barnstable County Coastal Resources Committee, staff member, 2006 - ongoing
Steering Committee, River Herring Warden Network, 2010 - ongoing
The 300 Committee Land Trust, Board of Directors, 2000 - ongoing
Falmouth Coastal Resources Working Group, 2000 – 2010.
Waquoit Bay National Estuarine Research Reserve Advisory Committee, 2011

AWARDS AND HONORS

Coastal America Partnership Award, Stony Brook Project Team, 2011
British Petroleum Postdoctoral Investigator Award, 1992
National Science Foundation Dissertations Symposium in Chemical Oceanography, 1991
American Association of Petroleum Geologists Research Grant Award, 1986
Geological Society of America Research Grant Award, 1985
Commonwealth Scholarship, Australian National University, Canberra, Australia, 1979
California State Scholarship, 1973

SELECTED PUBLICATIONS

Association to Preserve Cape Cod. 2013, 2012, 2011 and 2010. Annual Monitoring Reports for the Stony Brook Salt Marsh and Fish Passage Restoration Project. These reports provide pre- and post-monitoring data on herring counts, salt marsh vegetation, water quality, flow parameters, Phragmites coverage, and rare plant species. Provided to the Town of Brewster under a NOAA grant from the American Recovery and Reinvestment Act of 2009.

Association to Preserve Cape Cod. 2009. Frequently Asked Questions, Stormwater Utilities.

Horsley Witten Group. 2004. Towards an Ocean Vision for the Nantucket Shelf Region: Part I. Evaluation of Natural Resources of the Nantucket Shelf Region. Part II Recommendations for Protection and Sustainable Uses. Prepared for the Center for Coastal Studies, Provincetown, MA.

Horsley Witten Group. 2004. Guidebook to the Response Protocol Toolbox: Responding to Drinking Water Contamination Threats and Incidents. Prepared for the U.S. EPA Water Security Task Force.

U.S. Environmental Protection Agency. 2003. Relative Risk Assessment of Wastewater Management Options for South Florida. Report prepared for U.S. EPA, Office of Ground Water and Drinking Water, available at http://www.epa.gov/region04/water/uic/proposedrule.htm.

Urban Harbors Institute, U.S. EPA Office of Water, Oceans and Wetlands, and Horsley & Witten Group. 1999 – 2003. *Coastlines* Newsletter. Editor for *Coastlines*, the newsletter of the National Estuary Program (NEP).

Muramoto, J. 1995. Analysis of Bulk Sediment and Tissue Samples Collected During the April 1994 Post-Cap Survey of the Dioxin Capping Monitoring Program at the New York Bight Mud Dump Site. Prepared for the U.S. Army Corps of Engineers, Waterways Experimental Station, Vicksburg, MS.

Rhoads, D.C., J. Muramoto, C. Coyle, R.H. Ward, and G. Mooradian. 1994. Rapid *in situ* assessment of organic contaminants in aquatic sediments with the REMOTS^{R}-UV imaging spectrometer. Marine Technical Society, September 1994, 12 pp.

Muramoto, J. 1993. A Review of the Black Sea Environment and Nature of the Sediments. Technical Report to British Petroleum Exploration Operating Co., Ltd., U.K. WHOI Technical Memorandum.

Muramoto, J., S. Honjo, B. Fry, B.J. Hay, R.W. Howarth, and J.L. Cisne. 1991. Particulate reduced sulfur fluxes in the southern Black Sea, using time-series sediment traps. Deep Sea Research 38, Suppl. 2, pp.1151-1187.

Fry, B.H., H. Jannasch, C. Wirsen, J. Muramoto, S. King, D.J. Lane and F. Widdell. 1991. Stable isotope studies of the carbon, nitrogen and sulfur cycles in anoxic basins: the Black Sea, Cariaco Trench, and Fayetteville Green Lake, New York. Deep Sea Research 38, Suppl. 2, pp.1003-1019.

Muramoto, J. and D. Carey. 1991. A Review of Studies of Metal and Organic Contaminants in Sediments and Biota of the New York Bight Apex and Mud Dump Site. Report to U.S. EPA, Contract No. 68-C8-0061, Work Assignment 1-20.

Muramoto, J. 1991. Pathogenic Microorganisms and Microbial Indicators of Contamination in Sediments of the New York Bight Apex. Report to U.S. EPA, Region II, Contract No. 68-C8-0061, Work Assignment 1-20.

STACIE NICOLE SMITH

Consensus Building Institute

Stacie Nicole Smith is Senior Mediator and Director of Workable Peace at CBI, where she is a mediator, facilitator, coach, and trainer. Her work includes curriculum and training for international, national, and local government entities, NGOs, and schools; facilitation of multi-sector community and national stakeholder dialogues and collaborations; and assessment and mediation of national public policy issues. She specializes in facilitating highly complex and contentious groups, where identities, values and interests intertwine, in contexts involving environment issues (land use, water, energy), historic and cultural resources, health, and education.

Ms. Smith has provided process design, mediation, and facilitation for public processes in a wide range of settings and contexts, from local neighborhood disputes to national dialogues and negotiations, including recent projects facilitating a regional framework for water quality management planning, a local water quality management plan, a multi-stakeholder collaborative process to develop a preservation and use plan for a highly contentious historic resource of the National Park Service, and national negotiated rulemaking around priorities for funding construction of Bureau of Indian Affairs-funded schools. She has helped organizations and groups evaluate and resolve internal communication and policy challenges, and has facilitated dozens of local land use decision-making processes.

She has also designed and implemented training and curriculum development for negotiation, difficult conversations, and mediation for a range of clients and uses, including both face-to-face and on-line training workshops in negotiations, strategic communications, and partnerships for the United Nations Development Program (UNDP), the World Health Organization (WHO), UNAIDS, and the United Nations System Staff College (UNSSC); a didactic curriculum on Heritage Place Management for the Getty Conservation Institute; and workshops on an array of topics. As Director of Workable Peace, Stacie brings both academic and professional experience to the task of integrating negotiation and conflict management skills into high school history curricula.

Ms. Smith graduated from Brown University in 1994, earning a B.A. with Honors in American Social and Political Theory. Ms. Smith completed her M.A. degree in the teaching of Social Studies at Columbia University Teachers College in 1996. Ms. Smith is a Member of the Association for Conflict Resolution in both the Education and the Environment and Public Policy sections. She has taught a graduate course at University of Massachusetts Boston, and guest lectures in courses at Tufts University and Harvard Law School. Prior to CBI, Ms. Smith taught high school English and Social Studies at a small public high school in Brooklyn.

Ms. Smith has many publications, including co-author and co-editor of *Applying Consensus Building, Negotiation, and Conflict Resolution Methods to Heritage Place Management* (forthcoming, GCI), and *A Didactic Case Study of Jarash Archaeological Site, Jordan: Stakeholders and Heritage Values in Site Management* (GCI, 2010), co-authoring a book chapter in *Educating Global Citizens: Challenges and Opportunities* (2005, Teachers College Press), an article, "Normalizing Effective Conflict Management Though Academic Curriculum Integration: The Example of Workable Peace," Summer 2004, *New Directions for Youth Development*), and others.

238 Main Street, Suite 400
Cambridge, MA 02142
telephone (617) 492-1414
fax (617) 492-1919

1220 L Street, NW, Suite 901
Washington, DC 20005
telephone (202) 289-7444
fax (202) 289-5967

www.cbuilding.org

ERIC J. ROBERTS

Consensus Building Institute

Eric J. Roberts is an Associate at the Consensus Building Institute, where he designs and implements stakeholder engagement plans and situation assessments, mediates and facilitates multi-party engagements, and develops and delivers trainings. His areas of focus include sustainable development, water resources management, climate change adaptation, oceans and coastal management, and organizational governance.

At CBI, Mr. Roberts has worked on a variety of public and stakeholder engagement projects at various scales. Selected projects include:

- In Cambridge, Massachusetts, Mr. Roberts assisted in the design and facilitation of Technical and Expert Advisory Panel meetings and public workshops of up to approximately 140 participants to help the City and their contractors to present and receive feedback on the results of a Climate Change Vulnerability Assessment and collect community input on the upcoming adaptation planning phase of the project.
- In the region east of Cincinnati, Ohio, Mr. Roberts and a CBI team interviewed over 100 stakeholders from three communities to identify the range of stakeholder views about a proposed roadway relocation project, then drafted an assessment report highlighting possible ways the parties might move forward using a collaborative approach.
- He also co-created a public engagement strategy focused on the six New England states and co-facilitated more than 10 public workshops to assist the New England Regional Planning Body to gather feedback on the development of an ocean management plan from public and sector specific stakeholders.

Mr. Roberts worked in the public, non-profit, and private sectors prior to joining CBI. He worked for the State of Indiana and the Daviess County Soil and Water Conservation District to collect aquatic and terrestrial biological data to inform state fish consumption advisories and fisheries management plans and authored a watershed plan to address nutrient pollution from agricultural runoff. As a Peace Corps Volunteer in Paraguay, he managed community-based agroforestry projects and facilitated trainings on soil and water conservation and environmental and public health. In the non-profit world, he designed and launched a global outreach process and a secure online voting registration and ballot-casting platform to select civil society observers for the committees and subcommittees of the Climate Investment Funds As an assistant biologist and an environmental scientist in the private sector, Mr. Roberts worked with government and industrial clients to manage storm water, enhance stream and wetland restoration projects, complete Environmental Impact Statements, mitigate soil and water contamination, and ensure compliance with natural gas transmission pipeline integrity management policies.

In 2012, Mr. Roberts earned a Masters of Science in Natural Resources and the Environment from the University of Michigan, where he focused on environmental policy decision-making for natural resources and environmental co-management through civic-engagement, conflict management, and consensus building. He earned a Bachelor of Science in Public Affairs from Indiana University's School of Public and Environmental Affairs in 2004.

238 Main Street, Suite 400
Cambridge, MA 02142
telephone (617) 492-1414
fax (617) 492-1919

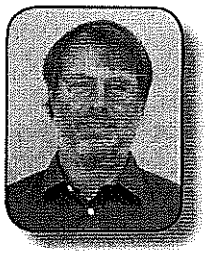
1220 L Street, NW, Suite 901
Washington, DC 20005
telephone (202) 289-7444
fax (202) 289-5967

www.cbuilding.org

Horsley Witten Group
Sustainable Environmental Solutions

Mark E. Nelson, P.G., LSP

Principal – Senior Hydrogeologist



Areas of Expertise

- Wastewater Management
- Integrated Water Management
- Hydrogeology/ Water Supply Development
- Groundwater Quality
- Environmental Permitting & Compliance
- Land Use Planning
- Smart Growth/ Low Impact Development
- Climate Change/ Energy
- Watershed Planning & Assessment
- Emergency Preparedness & Response
- Environmental Engineering
- Site Assessment & Remediation
- Training
- Meeting Facilitation
- Water Security

Professional Registrations

- Registered Professional Geologist, WI
- Licensed Site Professional, MA

FEMA Certifications

IS-800 NRP
IS-700 NIMS
IS-100 ICS
IS-200 ICS
IS-300 ICS
IS-400 ICS

Professional Affiliations

- Member, National Ground Water Association

Mark Nelson is a Senior Hydrologist and Principal with HW, and is responsible for the firm's Water Resource, Wastewater Planning, and Site Assessment and Remediation projects. Mark has more than 25 years of experience in groundwater modeling, surface water modeling, hydrogeologic investigations, and fate and transport analysis of contaminants in soil, sediments, and groundwater. He currently serves as the Program Manager for HW's $17 million contract with U.S. Environmental Protection Agency (EPA) Office of Ground Water and Drinking Water, providing technical advice on source water protection, climate adaptation and the Underground Injection Control Program. He is also the Program Manager for the firm's $22 Million contract with EPA's Office of Science and Technology. Mark has been an instructor for the EPA teaching workshops on wastewater planning, water security, ground water and surface water hydrology, Low Impact Design (LID) contaminant transport, estuarine and ground water modeling and wellhead and source water protection. He has also qualified as an expert witness in Massachusetts and Wisconsin.

REPRESENTATIVE PROJECTS

Support for the Development of the Strategic Plan for Climate Change and Water, US EPA's Office of Water: Project Manager for HW's work supporting the U.S. Environmental Protection Agency's Office of Water which is currently updating their strategic plan to address climate change impacts on water resources across the country. HW supported a two-day retreat of EPA, federal agency and state and tribal representatives who met to discuss current climate change adaptation activities and evaluate how current EPA programs are set up to address future impacts related to climate change, including changes in precipitation patterns and amounts that will impact water suppliers, changes in water temperature that will impact drinking water treatment facilities, sea level rise, loss of wetlands and flooding impacts on water and wastewater facilities. Since the retreat, HW has been assisting EPA staff in the development of a strategic plan outline and will provide continued support in the development of the overall strategic plan.

Integrated Water Resource Management Plan (IWRMP) for the Town of Brewster: Principal-In-Charge for integrated plan to protect the Town's water resources by addressing water quantity and quality impacts on surface water, groundwater, and adjacent tidal waters. The Town has water-related problems associated with continued steady growth and also faces new regulatory constraints in the form of a nitrogen TMDL and municipal (MS4) stormwater permits. Because the Town is not dominated by wastewater problems, a truly integrated approach is possible. The approach will address water supply, wastewater, and stormwater resources spatially (by watershed) and temporally (current versus future) by using a both engineering approaches and proposed code changes. The goal for the plan is to allow continued sustainable development while protecting the outstanding natural resources.

Horsley Witten Group
Sustainable Environmental Solutions

Mark E. Nelson, P.G., LSP
Principal – Senior Hydrogeologist

- Member, Association of Ground Water Scientists and Engineers
- Member, American Geophysical Union

Academic Background
Master of Science, Environmental Engineering, Oregon Health & Science University (formerly Oregon Graduate Center)

Bachelor of Science, Geology, Brown University

Sea Education Association, Woods Hole, MA

Water Management Planning, North Kingstown, RI: Assisted the North Kingstown Planning Department and the Water Department in the development of a long range water management plan for the community. The purpose of this planning is two-fold: 1) to develop conservation measures to reduce the seasonal peak water use in July and August in order to preserve water for future economic growth within the town; and 2) to develop management strategies to bring water withdrawals in town into compliance with future streamflow-based standards for the Hunt, Annaquatucket and Pettaquamscutt aquifer systems that are currently being developed by the Rhode Island Department of Environmental Management. Management options under consideration include changes to the town's increasing block rates to discourage excessive outdoor watering, incentive programs to reduce day-to-day potable water use, aquifer storage of peak river flows and wastewater reuse.

Cape Cod, Massachusetts, Energy Use Projections: Principal-in-Charge for the development of energy use projections for Cape Cod and the Islands in the year 2020. On behalf of the Electric Power Research Institute (EPRI), HW calculated several different scenarios incorporating smart growth and energy efficient building policies as well as expected future wastewater infrastructure needs. The calculations will assist the Region in developing strategies to meet energy reduction goals.

Hydraulic Fracturing Guidance Research and Analysis, US EPA: Program Manager overseeing HW's provision of research and analysis on technical issues related to hydraulic fracturing as it is now used in oil and gas development. HW is developing internal issue papers to support EPA's Permitting Guidance for Oil and Gas Hydraulic Fracturing Activities Using Diesel Fuels document that will assist oil and gas permit writers within the EPA Region.

Drinking Water and Wastewater System Training for Tribes, EPA OGWDW: Lead instructor for a nationwide series of three-day trainings of Tribal water and wastewater operators and Tribal leaders who received American Recovery and Reinvestment Act (ARRA) funding for water and wastewater projects. The workshops include group exercises, providing participants with relevant case studies and visual aids designed to provide training for operation, maintenance, and management of these systems. Hundreds of tribal operators will be trained under this ARRA-supported workshop series.

"Watershed Management Tools for Local Governments" Workshop, EPA Office of Wetlands, Oceans, and Watersheds: Co-instructor in a series of workshops on watershed management entitled, "Watershed Management Tools for Local Governments," which were designed to assist local governments and others working at the watershed level. The two general goals forming the foundation of the training sessions are, first, to integrate technical and scientific issues with regulatory and land stewardship techniques to manage coastal and inland watershed systems, and, second, to train individuals with scientific background in the language and practice of

watershed management while training watershed decision-makers in the language of watershed science. Over 40 of these workshops have been held in 14 States, U.S. Territories, and Indian reservations.

Low Impact Design Workshops for the Hawaii Office of Planning: Led a series of workshops across Hawaii focusing on how Low Impact Design (LID) techniques could support rural planning efforts across the state while protecting drinking water supplies and coastal water quality. A 150 page workbook was developed to provide detailed information on better site design principals and engineering specifications for best management practices for stormwater and wastewater planning. Opportunities for advanced treatment of wastewater for on-site, clustered and centralized wastewater treatment facilities were also provided. Four workshops were held in the four counties that comprise Hawaii.

Analysis of Fertilizer and Pesticide Use on Cape Cod for the Cape Cod Commission: Principal-in-Charge for a detailed analysis of the extent of fertilizer and pesticide use on Cape Cod. This involved research into state records on pesticide applications, research with a number of stakeholder organizations and coordination with the Commission on land use data to determine the relative percentage of fertilizer and pesticide use for each major land use, including residential, commercial, municipal, agricultural, utility rights-of-way and golf course areas.

Noman's Land Island, Wampanoag Tribe of Gay Head (Aquinnah), MA: Provided technical review of a Phase II Comprehensive Site Assessment and associated documents for Noman's Land Island, located south of Martha's Vineyard, Massachusetts. Mark evaluated the impacts of the U.S. Navy's use, since the 1940s, of the island as a bombing range. The review focused on impacts to soil and groundwater quality from hydrocarbons, explosives, and metals, and the potential danger of exposure to Tribal members visiting the Island. Mark also assisted the Tribe in the development of a sampling and Quality Control plan to quantify the uptake of contaminants by shellfish and fin fish surrounding the island.

Groundwater Resource Protection Plan, Nantucket, MA: Created a detailed water table map, using ground penetrating radar, for the Island of Nantucket, which was utilized to delineate groundwater recharge areas to freshwater and coastal ponds. Mark modeled the effects of saltwater intrusion on public and private water supplies and delineated existing and future nitrogen loading rates within critical resource areas.

Dissolved Oxygen TMDL Development for Brenner Bay, Vessup Bay and Mangrove Lagoon, St. Thomas, US Virgin Islands: Principal-in-Charge for the development of TMDL models for these three estuaries on St. Thomas. Each system was threatened by nutrient discharges that reduced the dissolved oxygen concentrations in the water column. In addition, organic matter within the bottom sediments also interacted with the overlying water, further reducing oxygen concentration below regulatory thresholds. Using existing data, the WASP6 model was selected to simulate the circulation of water within each embayment and calculate dissolved oxygen concentrations taking into account nutrient discharges from inlet streams, overland run-off and chemical interactions between the water column and underlying sediments.

Development of a Strategic Plan for Providence Water, RI: Principal-in-Charge for the development of a Strategic Plan for Providence Water. Providence Water supplies drinking water to the City of Providence and 16 other Rhode Island Communities. HW worked with the 250 employees of Providence Water to develop a Strategic Plan, with a focus on improving the internal operations of the utility. HW developed twelve strategic planning goals with input from a majority of the Providence Water employees; administered an anonymous survey of all Providence Water employees, management, and Board members; analyzed the performance of Providence Water relative to a peer group of other utilities; performed individual employee interviews; facilitated six focus groups to discuss the prioritization of goals and the realistic implementation of the proposed strategies; and conducted an organizational retreat. HW is also continuing to monitor the implementation of the Plan through a two-year review process.

Stanley M. Humphries

Education

University of South Carolina, Columbia, South Carolina
Master of Science, Geology, Spring 1977

University of South Carolina, Columbia, South Carolina
Bachelor of Science, Geology, Summer 1974

Professional Certifications and Affiliations

American Shore & Beach Preservation Association

Massachusetts Association of Conservation Commissions (formerly on the Board of Directors '92–'02)

Professional Experience

LEC Environmental Consultants, Inc.
Plymouth, Massachusetts (March 2006 – Present)
Senior Coastal Geologist

Mr. Humphries has 36 years of experience in coastal geomorphology, flood hazard mitigation, wetlands and waterways policy and regulations, environmental impact reporting, permit strategy and acquisition and expert testimony. His field experience has focused on resource delineations and functional assessments of the nearshore marine environment; coastal beaches, banks and dunes; barrier beaches; and, the 100-year coastal floodplain in Massachusetts. Project designs and reviews range from shore protection measures, dredging and dredged material disposal, piers and docks, beach and dune nourishment, to commercial and residential waterfront developments. Consultation typically includes project design and regulatory implications; land use impacts to wetlands wildlife and endangered species; permit and license applications; and public presentation to environmental boards, commissions, and agencies. Mr. Humphries has served on several state task forces, advisory committees, and working groups concerning coastal erosion and flood hazards, as well as being qualified as an expert witness in Massachusetts Land Court, several District and Superior Courts, Energy Facilities Siting Board and Massachusetts DEP Adjudicatory Hearings.

Ocean and Coastal Consultants, Inc.
Plymouth, Massachusetts (2003 – 2006)
Director of Massachusetts Office/Senior Project Manager

ENSR International, Inc.
Bourne, Massachusetts (1996 – 2003)
Regional Director/Senior Coastal Geologist

Fugro East, Inc.
Bourne, Massachusetts (1992 – 1996)
Regional Director/Senior Coastal Geologist

IEP, Inc.
Sandwich, Massachusetts (1982 – 1992)
Senior Coastal Geologist

Massachusetts Department of Environmental Management (1978 – 1982)

Heather McElroy
Natural Resources Specialist

Heather McElroy has served as the Cape Cod Commission's Natural Resources Specialist for the last 12 years, developing natural resource and land use policy for Cape Cod, and applying those policies through the Commission's regulatory program. Her work includes state and regional ocean planning, natural resources management, and green infrastructure planning. Heather participated in the Massachusetts Ocean Management planning process since that project started in 2008. She now serves on the Massachusetts Ocean Advisory Commission as the Cape Cod Commission's representative to that advisory body. She managed Barnstable County's 18 month regional ocean planning project, the Cape Cod Ocean Management Planning District of Critical Planning Concern (DCPC), coordinating staff, and technical and policy advisory committees. The DCPC resulted in the Cape Cod Commission's adoption of the Cape Cod Ocean Management Plan: http://www.capecodcommission.org/index.php?id=349&maincatid=76

Heather later managed the effort to carry forward the recommendations in the CCOMP into the county's Regional Policy Plan. Most recently she has facilitated the science panel convened in support of the Cape Cod Commission's update of the Section 208 Water Quality Plan for Cape Cod. She is currently working with a team of hydrogeologists, planners, and a GIS analyst on incorporating green infrastructure approaches to managing water quality in nutrient-impacted watersheds for the 208 plan.

Education:
Bachelor of Fine Arts, 1989
Cornell University, College of Architecture, Art, and Planning
Master of Arts, 1996
Tufts University, Department of Urban and Environmental Planning & Policy

Mark Borrelli

Associate Scientist, Center for Coastal Studies, Provincetown, MA 02667

EDUCATION

Institution	Major	Degree	Year
Tufts University	Geology	B.S.	1999
Univ. of North Carolina at Chapel Hill	Geological Sciences	M.S.	2001
Univ. of Rhode Island	Geoscience	Ph.D.	2008

CURRENT APPOINTMENTS

06/2012 – Present **Chair**, Dept. of Marine Geology, Center for Coastal Studies, Provincetown, MA

06/2012 – Present **Associate Scientist**, Dept. of Marine Geology, Center for Coastal Studies, Provincetown, MA

09/2009 – Present **Adjunct Professor**, Dept. of Environmental, Earth and Ocean Sciences, University of Massachusetts-Boston

His research interests include coastal sedimentary processes in general and understanding how storms, sea level rise and anthropogenic impacts affect the coast in particular. Recent and ongoing research includes: mapping the seafloor in shallow coastal waters, studying bedforms and sediment transport in the nearshore, collecting high, spatial and temporal resolution beach profiles, understanding the morphodynamics of tidal inlets and developing a new method to quantify change in salt marshes.

RECENT PUBLICATIONS

[1] Borrelli, M., Gontz, A.M., Smith,T.L., Shumchenia, E.J., Wilson, J.R., Giese, G.S. (2013) Onshore-offshore surficial geologic map of the North Truro Quadrangle, Barnstable County, Massachusetts. 1:24,000. Massachusetts Geological Survey, Open File Report. 2013-01. 1 sheet and digital product: Adobe PDF and ESRI ArcGIS database.

[2] Borrelli, M., Gontz, A.M., Wilson, J.R., Brown, T.L.B., Norton, A.R., Giese, G.S. (2012) Onshore-offshore surficial geologic map of the Provincetown Quadrangle, Barnstable County, Massachusetts. 1:24,000. Massachusetts Geological Survey, Open File Report. 2012-01, 1 sheets and digital product: Adobe PDF and ESRI ArcGIS database.

[3] Borrelli, M., Norton, A.R., Brown, T.L.B., (2012). Nearshore resource characterization maps: marine spatial planning, capacity building and coastal science in Massachusetts. Abstract B1070 presented at American Geophysical Union Ocean Sciences Biennial Conference. Salt Lake City, UT., 20-24 Feb. 2012

[4] Brown, T.L.B., Norton, A.R., Rogers, J., Gontz, A., Borrelli, M., (2012). Creating a high-resolution, high accuracy, seamless map of the marine-terrestrial interface using swath bathymetry, intertidal structures, and terrestrial LiDAR. Presented at American Geophysical Union Ocean Sciences Biennial Conference, Salt Lake City, UT., 20-24 Feb., 2012.

Town of Brewster

2198 Main Street
Brewster, MA 02631-1898
Phone: (508) 896-3701
Fax: (508) 896-8089

Office of:
Board of Selectmen
Town Administrator

June 12, 2015

Patricia Bowie
Coastal Resilience Specialist
Massachusetts Office of Coastal Zone Management
251 Causeway Street, Suite 800
Boston, MA 02114

Dear Ms. Bowie,

On behalf of the Brewster Board of Selectmen, I am pleased to submit this grant application to allow the Town to develop a Coastal Adaptation Strategy. The Town will employ a facilitated public engagement process to expand citizen understanding of local risks, values and vulnerabilities to a changing climate, and develop consensus on the major threats to our coast and the key issues to be evaluated into the future. Through this collaborative process, the Town will assess options for reducing risk, both in practice and policy, based on this consensus and the vulnerability assessment. The final product will be a Coastal Adaptation Strategy that the Town will use to establish priority actions and timeframes from their implementation.

We've learned the hard way that without thorough community engagement and a more comprehensive approach to coastal adaptation and resiliency, projects that are technically well designed and appropriate for the location, can be halted in either the funding or permitting process if citizens object to the project. Brewster's Breakwater beach retreat, dune restoration and green stormwater management plan, funded in last year's round of CZM Coastal Community Resiliency grants, is now in the DEP appeals process. Citizen opposition has many layers; however an important message out of this is the need for a more comprehensive plan for addressing coastal change.

Last year Brewster was fortunate to receive a CZM Coastal Resiliency grant to develop a sediment budget of our entire coast and to assemble data on our coastal natural resources adjacent to our 10 town landings. This information, along with engineering assessments of our town landing infrastructure, is being used to develop recommendations for future management at these locations. These analyses and recommendations will be a critical part of the proposed vulnerability assessment and also inform the discussion of adaptation and resiliency options.

This grant application builds on the work started with the Coastal Resiliency Grant. A science-based foundation for policy dialogue on coastal resilience and adaptation is essential to fully communicate the risks to our coastal properties. A measured and detailed public engagement process is the next step in adapting to Brewster's future sea level rise and erosion issues.

A Coastal Adaptation Strategy will be used in our emergency planning and response, as it will identify areas vulnerable to coastal change and strategies to reduce long term risk. The Strategy is particularly important in updating and implementing Brewster's Hazard Mitigation Plan. The Strategy is valuable for the town's capital planning as it can guide town investments over multiple

years.

The Board of Selectmen believes the development of a Coastal Adaptation Strategy that fully engages the public is critical to our future coastal management decisions. Brewster has demonstrated experience in managed retreat and coastal restoration. I urge you to support this important proposal to build coastal resilience.

Sincerely,

Ben deRuyter, Chair
Brewster Board of Selectmen

Brewster Fire Department

1657 Main Street
Brewster, MA 02631
Phone 508-896-7018 Fax 508-896-4245

June 11, 2015

Patricia Bowie, Coastal Shoreline & Floodplain Manager
Executive Office of Energy & Environmental Affairs
Massachusetts Office of Coastal Zone Management
251 Causeway Street, Suite 800
Boston, MA 02114

Re: Letter of support for the Town of Brewster's proposal *Developing a Coastal Adaptation Strategy in Brewster* to the CZM FY16 Coastal Community Resilience Grant Program

Dear Ms. Bowie,

The Town of Brewster Fire & Rescue Department is pleased to support Brewster's proposal- *Developing a Coastal Adaptation Strategy in Brewster*- to the Massachusetts Coastal Zone Management Department to support the Town's efforts to understand and plan for ongoing and future coastal change.

I have cooperatively worked with our town GIS staff to develop estimates of properties and infrastructure that will be affected by rising sea levels and potential future storm events and coastal flooding. Based on this work, we have found the need to develop and establish long term plans to replace vulnerable coastal infrastructure and to identify and provide access points to these areas for emergency vehicles and personnel as some of the most critical components of our community's Emergency Response Plan include our coastal beach areas.

The proposed development of a coastal adaptation strategy will be a key part of how Brewster adapts and keeps its citizens safe. These planning efforts will also be essential for our citizens to understand the risks inherent in living in a low lying coastal environment.

I believe this project will also provide transferrable results that can be used by other coastal communities, on and off Cape Cod. Brewster's previous experience in implementing and managing retreat and coastal restoration projects demonstrates a firm commitment to the effective use of these requested funds. I urge you to support this important proposal.

Sincerely,

Robert Moran
Chief of Department

BREWSTER POLICE DEPARTMENT
Chief Richard J. Koch, Jr.
631 Harwich Road
Brewster, Massachusetts 02631
Phone 508-896-7011 www.brewsterpolice.org Fax 508-896-4513

June 11, 2015

Patricia Bowie , Coastal Shoreline & Floodplain Manager
Executive Office of Energy & Environmental Affairs
Massachusetts Office of Coastal Zone Management
251 Causeway Street, Suite 800
Boston, MA 02114

Re: Letter of support for the Town of Brewster's proposal *Building a Coastal Adaptation Strategy in Brewster* to the CZM FY16 Coastal Community Resilience Grant Program

Dear Ms. Bowie,

I am pleased to support Brewster's proposal- *Building a Coastal Adaptation Strategy in Brewster* - to the Massachusetts Coastal Zone Management Department to support the Town's efforts to support the Town's efforts to understand and plan for ongoing and future coastal change.

In my 28 years of police experience in Brewster, I have witnessed an increasing trend of erosion to our coastline. In recent years we have had stronger storm events undermine and damage homes, damage roads and parking areas at the beach, and flood an important evacuation route. Brewster needs to develop and establish long term plans to replace or change vulnerable coastal infrastructure and provide for access by emergency vehicles and personnel during and after these events.

The proposed planning efforts will be a key part of how Brewster keeps its citizens and first responders safe. These planning efforts will also be essential for our citizens to understand and adapt to the risks inherent in living in a low lying coastal environment.

This project will also provide transferrable results that can be used by other coastal communities. Brewster has demonstrated experience and success in managed retreat and coastal restoration. I urge you to support this important proposal.

Sincerely,

Richard J. Koch Jr., Chief
Town of Brewster Police Department

TOWN OF BREWSTER
2198 MAIN STREET
BREWSTER, MA 02631
PHONE: (508) 896-3701 EXT 1135
FAX: (508) 896-8089
CONSERVATION@ BREWSTER-MA.GOV

OFFICE OF
CONSERVATION COMMISSION

June 11, 2015

Patricia Bowie, Coastal Shoreline & Floodplain Manager
Executive Office of Energy & Environmental Affairs
Massachusetts Office of Coastal Zone Management
251 Causeway Street, Suite 800
Boston, MA 02114

Re: Letter of support for the Town of Brewster's proposal *Building a Coastal Adaptation Strategy in Brewster* to the CZM FY16 Coastal Community Resilience Grant Program

Dear Ms. Bowie:

I am pleased to support Brewster's proposal- *Building a Coastal Adaptation Strategy in Brewster* - to the Massachusetts Coastal Zone Management Department to support the Town's efforts to understand and plan for ongoing and future coastal change.

I am the town staff that assists the public in filings under the State Wetlands Protection Act and our local bylaw. Based on my experience with numerous coastal filings and the public comments associated with them, many Brewster coastal residents do not fully understand the coastal processes and how they shape the changing coastline. In addition, there seems to be little local consensus on how sea level rise and a changing climate may affect our coast.

The proposed vulnerability assessment will help determine what that risk may entail to public and private properties and the coastal structures that are designed to protect them. The public engagement and outreach detailed in the grant application will assist with educating the public.

This project will also provide transferrable results that can be used by other coastal communities. Brewster has demonstrated experience and success in managed retreat and coastal restoration. I urge you to support this important proposal.

Sincerely,

James Gallagher, Conservation Administrator
Town of Brewster Conservation Department

Town Of Brewster
2198 Main Street
Brewster, Massachusetts 02631-1898
(508) 896-3701 x1150
FAX (508) 896-8089

Office of:
Planning Department
Susan M. Leven AICP
Town Planner

June 11, 2015

Patricia Bowie Coastal Shoreline & Floodplain Manager
Executive Office of Energy & Environmental Affairs
Massachusetts Office of Coastal Zone Management
251 Causeway Street, Suite 800
Boston, MA 02114

Re: Letter of support for the Town of Brewster's proposal *Building a Coastal Adaptation Strategy in Brewster* to the CZM FY16 Coastal Community Resilience Grant Program

Dear Ms. Bowie:

As the Planner for the Town of Brewster, I would like to add my support to Brewster's proposal - *Building a Coastal Adaptation Strategy in Brewster* - to the Massachusetts Coastal Zone Management Department to support the Town's efforts to understand and plan for ongoing and future coastal change.

In addition to my duties as Town Planner, I also manage the Town's water planning process and development of the Town's Integrated Water Resources Management Plan (IWRMP). This connection of land use planning and water planning has enabled us to more effectively address water issues in Brewster. In recent years, Brewster has adopted a number of by-laws and regulations aimed at protecting the Town's land and water resources including the first conservation subdivision by-law adopted on Cape Cod -- and an illicit discharges by-law for municipal storm drains. Work is continuing on a zoning amendment to expand the Town's stormwater regulations, particularly as they apply to new development; and a fertilizer management by-law was passed at a recent Town Meeting.

Public outreach and consensus building on the scope of the issues are important first steps to developing an adaptation plan from which the Town can establish priorities for funding and implementation.

I believe this project will also provide transferrable results that can be used by other coastal communities, on and off Cape Cod. I urge you to support this important proposal.

Sincerely,

Susan M. Leven AICP
Town Planner

Town of Brewster
DEPARTMENT OF PUBLIC WORKS
201 Run Hill Rd.
Brewster, MA 02631-1898
Phone: (508) 896-3212
Fax: (508) 896-4540

Patrick Ellis
Interim Superintendent

James Jones
Foreman

June 11, 2015

Patricia Bowie Coastal Shoreline & Floodplain Manager
Executive Office of Energy & Environmental Affairs
Massachusetts Office of Coastal Zone Management
251 Causeway Street, Suite 800
Boston, MA 02114

Re: Letter of support for the Town of Brewster's proposal *Building a Coastal Adaptation Strategy in Brewster* to the CZM FY16 Coastal Community Resilience Grant Program

Dear Ms. Bowie:

The Town of Brewster Department of Public Works is pleased to support Brewster's proposal- *Building a Coastal Adaptation Strategy in Brewster*- to the Massachusetts Coastal Zone Management Department to support the Town's efforts to understand and plan for ongoing and future coastal change.

Among towns on Cape Cod, Brewster is a proven leader in protecting and restoring its natural coastal ecosystems. During this current fiscal year we are improving stormwater collection and infiltration on three of the seven roads leading to our beaches. These roads and landings leading to the coast cannot handle the increasing stormwater load and effects of rising sea level. Our coastal landings take the brunt of winter storms, Nor'easters and hurricanes. The combination of being open to northeast and northwest winds, and tidal ranges that can reach over 10 feet at high tide makes Brewster especially vulnerable to coastal storms and storm surge.

Public outreach and consensus building on the scope of the issues and potential ways to mitigate damage are the necessary first steps to developing an adaptation plan from which the Town can establish priorities for funding and implementation.

I believe this project will also provide transferrable results that can be used by other coastal communities, on and off Cape Cod. Brewster has demonstrated experience in managed retreat and coastal restoration. I urge you to support this important proposal.

Sincerely,

Patrick Ellis, Superintendent
Brewster Department of Public Works

TOWN OF BREWSTER
2198 MAIN STREET
BREWSTER, MA 02631
PHONE: (508) 896-3701 EXT 1125
FAX: (508) 896-8089
WWW.TOWN.BREWSTER.MA.US

OFFICE OF
BUILDING DEPARTMENT

June 11, 2015

Patricia Bowie, Coastal Shoreline & Floodplain Manager
Executive Office of Energy & Environmental Affairs
Massachusetts Office of Coastal Zone Management
251 Causeway Street, Suite 800
Boston, MA 02114

Re: Letter of support for the Town of Brewster's proposal Building a Coastal Adaptation Strategy in Brewster to the CZM FY16 Coastal Community Resilience Grant Program

Dear Ms. Bowie:

I fully support The Town of Brewster's proposal – Building a Coastal Adaptation Strategy in Brewster – to the Massachusetts Coastal Zone Management Department to support the Town's efforts to understand and plan for ongoing and future coastal change.

As a Massachusetts Certified Building Commissioner I have witnessed firsthand the results of extreme natural events that are exacerbated by building in potentially hazardous locations such as low lying or flood prone areas. With predicted sea level rise, those areas as mapped will expand and additional properties will be at risk of damage. The proposed vulnerability assessment will also aid in determining what that risk may entail. The proposed public engagement and outreach detailed in the grant application, I believe to be essential and will assist with these efforts.

This project will also provide transferrable results that can be used by other coastal communities. Brewster has demonstrated experience and success in manage retreat and coastal restoration. I urge you to support this important proposal.

Sincerely,

Victor E. Staley
Building Commissioner

VS/dec

BREWSTER LADIES' LIBRARY ASSOCIATION
1822 MAIN STREET
BREWSTER, MASSACHUSETTS 02631

FOUNDED 1852

June 11, 2015

Patricia Bowie , Coastal Shoreline & Floodplain Manager
Executive Office of Energy & Environmental Affairs
Massachusetts Office of Coastal Zone Management
251 Causeway Street, Suite 800
Boston, MA 02114

Re: Letter of support for the Town of Brewster's proposal *Building a Coastal Adaptation Strategy in Brewster* to the CZM FY16 Coastal Community Resilience Grant Program

Dear Ms. Bowie,

I am pleased to support Brewster's proposal- *Building a Coastal Adaptation Strategy in Brewster* - to the Massachusetts Coastal Zone Management Department to support the Town's efforts to understand and plan for ongoing and future coastal change.

The mission of the Brewster Ladies' Library is to be a cultural and life-long learning community center that provides free access to a range of resources, activities and professional assistance to further enhance the quality of life. In 2011, the Library went through a strategic planning session involving focus groups, surveys and public outreach to discuss our future and the future needs of the community. This process was very successful and is in many ways similar to the approach detailed in the proposed grant. The Library would be please to help with the public engagement and outreach detailed in the grant application, to include providing space for public meetings, and for distribution of brochures and materials describing the study and its outcomes.

This project will provide transferrable results that can be used by other coastal communities. Brewster has demonstrated experience and success in managed retreat and coastal restoration. I urge you to support this important proposal.

Sincerely,

Kathy Cockcroft, Director
Brewster Ladies'Library

June 12, 2015

Patricia Bowie
Coastal Resilience Specialist
Massachusetts Office of Coastal Zone Management
251 Causeway Street, Suite 800
Boston, MA 02114

Dear Ms. Bowie,

The mission of the Brewster Chamber of Commerce includes "to strengthen, promote and support environmental sensitivity" as we recognize that our environment IS our economy. To that end, we support this grant application submitted by the Town of Brewster for the development of a Coastal Adaptation Strategy. We also strongly approve the planned public education process that will be followed to help citizens understand local risks, values and vulnerabilities to a changing climate, and develop consensus on the major threats to our coast. The final product, a Coastal Adaptation Strategy, will be used to establish priority actions and timeframes from their implementation.

Brewster has learned the hard way that without community engagement and a more comprehensive approach to coastal adaptation and resiliency, projects that are considered by the Town and its consultants to be technically well designed and appropriate for the location, can be halted in either the funding or permitting process if citizens object to the project.

If you have any questions, please contact Chris Miller, Director of Brewster's Natural Resources Department at cmiller@brewster-ma.gov.

Thank you for considering this proposal.

Sincerely,

Ms. S. Kyle Hinkle
Executive Director